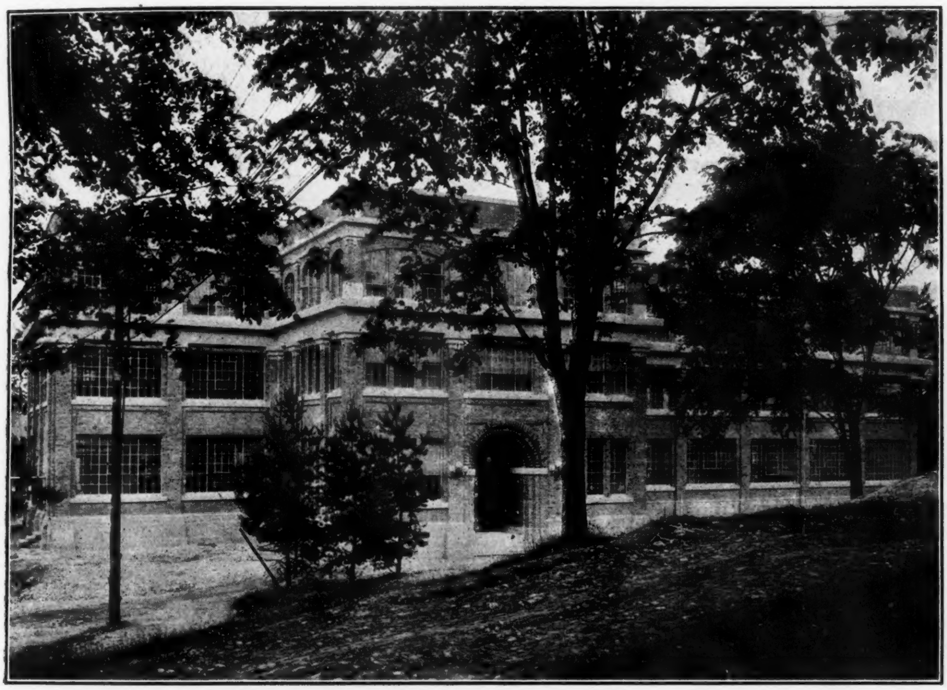
COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XVII JULY, 1912 No. 7



RAND HALL, SIBLEY COLLEGE, CORNELL UNIVERSITY.

RAND MEMORIAL HALL

The building which we see here, Rand Memorial Hall, is the latest addition to the unique assemblage of noble structures which constitute the habitat of Cornell University. It is the gift of Mrs. O. R. Lang, the daughter of Jasper Raymond Rand, who, with his brother, Addison Crittenden Rand, founded the Rand Drill Company. It is a memorial to Mrs. Lang's father and uncle, and to her brother, Jasper Raymond Rand, Jr., later of the firm and a former student of Sibley College.

The gift of this building fitted perfectly into the general scheme of extension the planning of which has been compelled by the continuing increase in the number of Sibley College students. These plans call for four new buildings to be occupied respectively by the mechanical laboratory, the electrical laboratory, the forge and foundry and the machine and pattern shop. The first three of these buildings will stand on ground occupied in part by present structures, while this building, the last of the series but the first to materialize, has been erected upon ground previously unoccupied.

and its erection before the others are torn down will enable instruction to be carried on without interruption.

The building is 164 feet long and 50 feet wide, is divided into 11 bays, and has an attached wing 45x31 feet. The machine shop will occupy the ground floor and the patternshop the top floor, the middle floor being for growth; and it will be particularly useful as a temporary location for parts of other departments during the transitional period of reconstruction. The building is of modern factory type with large windows, but modified architecturally to conform with the surrounding buildings and with the character of the university buildings as a whole. It is not necessary to go into a detailed description here. It represents throughout the best of modern construction and equipment.

In the formal inauguration of the building the following order was followed, President Schurman presiding:

Singing "Alma Mater," by the audience.
Address by Mr. George Westinghouse.
Song, "Cornell," led by Glee Club Quartet.
Address by Mr. F. A. Halsey.
Presentation of Key to Rand Hall by Mrs. Lang.
Acceptance of same by President Schurman.
Presentation of Key by Dr. Schurman to Director Smith.
Director Smith's acceptance of same.

The address of Mr. Westinghouse was a large and masterful appreciation of the modern profession of engineering, and of the great work done by the founders of Cornell and of those who have carried and are carrying it along upon so high a plane. The concluding passage was as follows:

I cannot adequately touch upon the other distinction of this occasion, at it demands a facility of expression which I do not possess; but Mrs. Lang will believe me when I say that there is a quality conveyed with her most generous gift that will ever enshrine high regard and the utmost respect in the hearts of all Cornellians for herself and for those she has honored in the naming of Rand Hall, for it is a woman's tribute to an art absolutely dominated by man, and this unique and gracious feature will render it the more precious and stimulating to all concerned in administering or receiving education in Cornell University. Our expressions of gratitude to her include a full recognition and appreciation of the unusual as well as the very valuable and timely nature of her gift.

The principal part of Mr. Halsey's address appears on other pages of the present issue. Being one of the earlier alumni of Cornell and also later and for many years a business worker with the Rands he was perhaps better qualified than any other man living to bring the two together as he did in his reminiscences of both. He paid the highest possible tribute to the memory of the Rand brothers by simply telling the straight truth about then as he knew them.

Mrs. Lang for her part of the programme said:

My first visit to Cornell University was made nineteen years ago, and scarcely a year has passed without my returning here. For a number of years we spent the entire summer at our cottage on the west shore of Cayuga Lake, and I am afraid I tired out many a visitor by insisting upon showing them all the interesting things to be found on this campus. During all this time I have been familiar with the Sibley shops and with the work done in them. If I had been a man I would have been at work in them myself. (Great applause).

I have seen the college grow and outgrow the shops, and so it is a great satisfaction to me that the opportunity has offered for me to provide this new one. Now that the building is completed it is with great pleasure that I hand to the Honorable President of Cornell University the key of Rand Hall. (Long continued applause followed by three cheers for Mrs. Lang.)

A drill hole exceeding a mile in depth is being put down in Kanawha county, West Virginia, by the Edwards Oil Co. It is stated that the final depth of this hole will be limited only by the capacity of the drilling equipment.

Citizens from Port of Spain are scientifically planting a large cocoanut estate in Tobago. After the growth on the land is cut and burned stump pullers are used. The first machine bought in the United States worked so satisfactorily that more have been ordered. It may be supposed that they will learn later of our recent use of dynamite for this work.

CULTURE IN THE EDUCATON OF ENGINEERS*

At one of the meetings of the American Institute of Mining Engineers, held in the hall of the Sheffield Scientific School at New Haven, a discussion arose as to whether or not sufficient importance was given to cultural studies in our scientific schools. A diagram was exhibited showing graphically the relative proportion that culture bore to other studies in the various colleges. In some there was a wide distribution of cultural work, in others the proportion was small, and in a few cases it was shown that these studies were entirely omitted in the curriculum.

During recess, a group of students were discussing the subject; one of them, a senior, said, "I don't see why they should *learn* a person culture in a scientific school." This remark, made in my presence, so impressed me as a concrete example of neglect in true educational lines that it has been chosen as a text for what is to follow.

Education in its broadest sense is mental and moral training. High schools and colleges differ from common schools in that they aim at higher planes of mental and moral life. The small boy is taught by stuffing, as one puts saw-dust in a doll; this is because his mind has not grown to the stage when it can think for itself. Impressions are received and transfixed by memory: the process is one of mental photography: the moral code is learned by rote as though it were the multiplication table.

Not so with the older, the college student: his highest aim in education is to learn to think for himself. "If you are a student force yourself to think independently; if a teacher compel your youth to express their own minds" writes Dr. Osborn of Columbia; and again, "The lesson of Huxley's life and the result of my own experience is that productive thinking is the chief *means* as well as the chief *end* of education."

Now, what is productive thinking? Let me answer this question by giving you Huxley's definition of culture: "The pursuit of any art or science with the view of its improvement." The storage process is of paramount importance only when applied to elementary education. It is but the auxiliary of the scholar who has passed from the junior to the senior stage of student life, and who aims to do things in the world. The pursuit of facts is a mathematical study. We learn of things that exist as a result of divine and human creation: The earth is round and it is composed of land and water. Water is hydrogen and oxygen combined. The square of the hypothenuse of a right angle triangle is equal to the sum of the squares of the other two sides. How elementary are these facts! It is important that we should know them; but even a large volume of facts when stored in the human mind is powerless to add one cubit to progress. It is like putting a pair of legs on the Encyclopedia Britanica and expecting it to do something. Knowledge is power, but reason is power in action.

Mr. James Gayley of the U. S. Steel Corporation told me recently that the professor at Lafayette College who taught him how to think made so deep an impression upon him that it has lasted throughout his life. Mr. Gayley is distinguished for what he has done as a metallurgical engineer. His life has been one of productive thinking: he has pursued science with the view of its improvement. That teacher, Mr. Gayley said, once gave him a solution containing iron, and instead of instructing him how best to precipitate the metal he told him to try three or four ways of doing it and report which was best. This led directly to thought and reason and built up a master mind among engineers. We may still heed the voice of old Carlyle crying from the heathery hills of Duncore, "Produce! Produce! Were it but the pitifullest infinitesimal fraction of a product, produce it in God's name! 'Tis the utmost thou hast in thee: out with it, then."

Where among all the professions do we get the results that come through productive thinking as from engineering? The engineer is the architect of the world's progress. Transportation in railways and ships, in motor cars and aeroplanes, is the productive thinking of mechanical engineers woven into our industrial life. The men who did these things were students of science, not that they might be mere storehouses of knowledge; but that they might produce. Civil, electrical, chemical and mining engineering are fields which afford infinite opportunities for research and progress. If

---

**Address by William L. Saunders, Sc. D., at the 38th Annual Commencement of the Colorado School of Mines, Golden, Colo., May the 24th, 1912.*

you men of the future do not rise to your chances in these lines it is not because the fields are not still open for cultivation and growth, but rather through your own inefficiency or perhaps your topheaviness.

"In vain our toil
We ought to blame the culture, not the soil."

Even Huxley feared that men might be overfed scientifically when he said: "An exclusively scientific training will bring about a mental twist as surely as an exclusively literary training. The value of the cargo does not compensate for a ship's being out of trim; and I should be very sorry to think that a Scientific College would turn out none but lop-sided men."

All this bears upon culture in its broadest sense. Productive thinking is the most important form of culture. It makes for power refinement, progress, knowledge, taste, civilization. The subject, you see, is a very broad one; the obligation upon you as students of science is equally broad. Take care that you be not "lop-sided men."

A graduate of the Colorado School of Mines, like all graduates of the higher institutions of learning, misses his opportunities and discredits his college if he does not carry throughout all his walks of life the imprint of the educated man. Noblesse oblige is a degree, and an obligation, which is uniformly conferred upon all college men.

To carry this obligation properly one should study culture in all its phases and in its broadest sense. Study it as an undergraduate and study it still harder and more fully through all your post graduate life. To this end let us accept and profit by that definition of culture given us by Mathew Arnold—"acquainting ourselves with the best that has been known and said in the world." A professor at Wellesley College defined culture to the students as "that which is left after all else learned at College is forgotten."

Virtue and moral training belong to cultural work in the education of engineers. It is a mistake to suppose that schools and colleges are places for mental training only. Physical exercise through athletics is just as much a part of one's college life nowadays as the study of mathematics; the one helps the other. Emerson said "Archery, cricket, gun and fishing rod, horse and boat, are all educators, liberalizers." To the engineer physical training is of value in order to fit him for out-door work. Moral training is of even greater importance. Locke has placed virtue first in defining the objects of education. Wisdom he puts next, and then good breeding; last of all learning. It is more the province of the teacher than of the student to safeguard and train the character by precept and example, for, after all, "the foundation of culture, as of character, is at last the moral sentiment. This is the fountain of power."

It is a common saying that manners make the man. Good manners afford us easy lures with which to win friends and facile weapons to conquer enemies. Manners adorn the gentleman and smooth the way of the educated man through the world. Manners are never born in men; but they are bred by association and study. Like oil on the journals of an engine they banish friction and promote efficiency. There are many reasons why we should be polite, but the best reason is because it pays; it costs nothing.

It is said of William, Earl of Nassau, that he won a subject from the King of Spain every time he put off his hat. So engaging were the manners of Charles James Fox that Napoleon said of him on the occasion of his visit to Paris in 1805, "Mr. Fox will always hold the first place in an assembly of the Tuileries." "My gentleman," said Emerson, "will out-pray saints in chapel, out-general veterans in the field, and outshine all courtesy in the hall. He is good company for pirates and good with academicians; so that it is useless to fortify yourself against him; he has the private entrance to all minds, and I could as easily exclude myself as him."

Good speech is a rule of manners. It always avoids exaggeration. Moderation in language and tone is the trade mark of good breeding, and good breeding is after all mainly a matter of self culture. Madame de Stael valued conversation above everything, and so engaging was she in that art, that a prominent lady of France said of her, "If I were Queen, I should command her to talk to me every day."

The man of education mixes with the right kind of people and reads good books. Books lead us into pleasant paths of culture and happiness. Read that you may avoid worry; read that too much hard thinking may not dull the

edge of intelligence and sap the roots of memory; read that you may know what has been done in the world; read that you may acquire that power which comes from knowledge; read that you may learn to value the example of great men's lives; that through them you may know that the grave is not the goal of life. Montaigne had a passion for books and never travelled without them; he said that reading roused his reason and employed his judgment rather than his memory.

But of greater importance than good speech and reading, of higher value to the engineer than manners, is ability to write good English. Engineers are not given to public speaking; they pride themselves in being workers; they compare themselves with General Grant, who did things. It is very true that the engineering profession is one of practical work; but no one can hope to achieve prominence in this profession who cannot write good understandable English. An engineer may not talk, but he must make reports; he must write letters; he should draw specifications and plans. To do these things properly he must command and know how to use the tools of language. Lord Bacon tells us that "reading makes a full man, conversation a ready man, and writing an exact man." Engineering is an exact science; accuracy is the one column on which the whole structure is reared. To write clearly and accurately can hardly be called an accomplishment, it is really a necessity. No college course is complete, whether it be a classical, scientific, medical or law course, without a thorough training in English. No graduate is worthy to be called an educated man who does not speak and write good English. It lifts a man above the common; it makes him bigger than his business or profession; it trims the ship of knowledge, and puts oil on rough places; it makes the man.

Margaret Fuller said that the object of life is to grow, and James Freeman Clarke has written a lecture upon this subject, "Man's Duty to Grow." A post graduate course in self-culture will tend to upward growth. Such a course is open to every one. The greatest opportunities for that education which unfolds the whole nature of man are those which are opened when we close the college door behind us. Graduation only marks the beginning of education to one whose face looks forward and upward. Let us build high; "they build too low who build beneath the stars." Build so that life and strength and growth may vitalize the whole structure; build on lines that are straight; build so that every root and branch of the tree of knowledge lends support and does not add a twist to the whole; build that men may see in you not alone skill and wisdom, but honor, culture, manhood, example; study to improve self—

"For virtue only makes our bliss below,
And all our knowledge is ourselves to know."

OXYGEN ADDITIONS TO THE FURNACE BLAST

According to the report of Dr. F. W. Lührmann, of Berlin, to the Blast Furnace Committee of the Verein Deutscher Eisenhüttenleute on this subject, the managements of furnaces in Mülheim-Ruhr, in Ougrée and in Kratzwieck are using small oxygen additions introduced into the blast whenever the furnaces are working cold. They believe that a steady enrichment of this nature would be detrimental to the furnace lining. Dr. Lührmann, on the other hand, holds that with our advanced knowledge on cooling methods, this danger is not a very real one. The oxygen added is in the form of "Linde air," or 50 per cent. oxygen and 50 per cent. nitrogen. It is made by evaporating liquid air to a gas with 95 per cent. oxygen, and then further diluting with air to give the above mentioned composition. In the case of blast enrichment, naturally, the liquid air would be evaporated directly into the blast pipe and proportioned to give the higher oxygen percentage desired. An installation to furnish 17,500 cubic ft. of oxygen per hour would occupy a space 125 ft. square, and cost about $100,000, requiring 800 h. p. to operate it. Dr. Lührman finds that for every 1 per cent. oxygen addition to the blast volume, there is a possible rise in temperature of about 100 deg. F., not taking into consideration the specific heat of gases, etc., or 2,830 deg. F., as compared with the theoretical temperature of the CO obtained by burning carbon in air. This 1 per cent. oxygen addition to the blast volume, in a furnace of 240 tons daily capacity would add $2.50 per ton to the cost of the pig-iron produced, this being based upon a cost five times as high as that given by interested manufacturers. Should their price be correct the additional cost would drop down to $0.50 a ton of pig-iron made, and this cost is well worth while investigating with a view of emergency use when trouble sets in.

OZONAIR VENTILATING IN THE LONDON "TUBE"

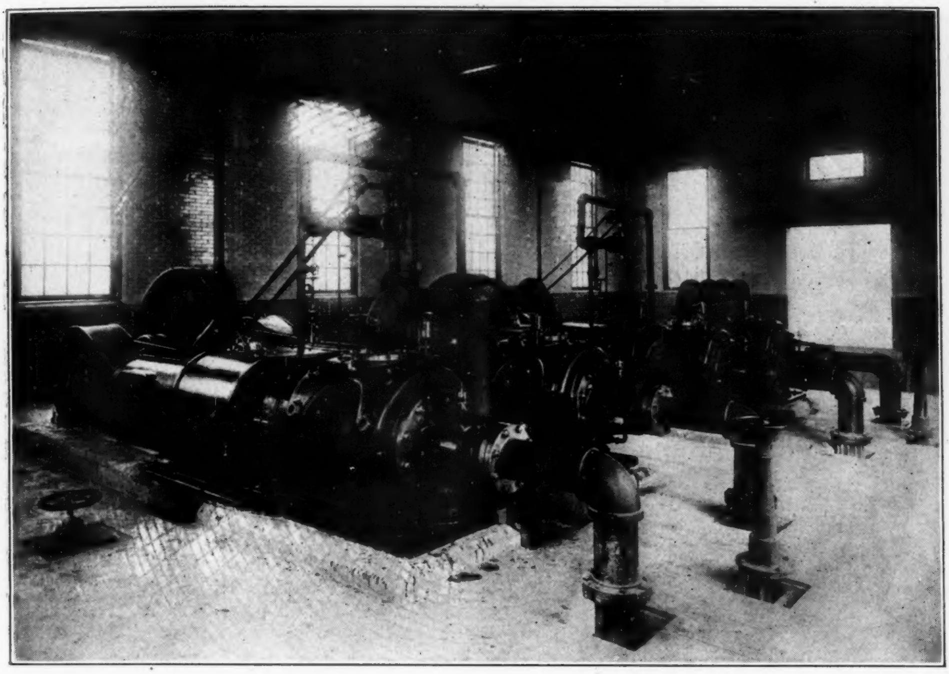
This system has recently been put into service by the Central London Railway. During the eleven years which have elapsed since its opening this railway has been ventilated on the exhaust system, the method consisting in closing all the doors underground for a certain period after the running of the last train, and drawing air right through the tube from one end to the other by means of a 200-horse power exhaust fan fixed at Shepherd's Bush. This thorough cleaning out every night was supplemented by a continuous running exhaust fan at the British Museum Station, and the natural ventilating action of the running trains. In view, however, of the increasing traffic, and the projected opening of extensions, the directors decided to instal a more positive system of ventilation. The railway runs a distance of nearly seven miles, and comprises two separate tunnels, having an aggregate length of about 13 miles. With the exception of a very short length between the first two stations, the railway is entirely underground. The "up" and "down" lines are in practically separate tunnels, each 11 ft. 8 in. in diameter, pierced in the London clay and formed of segments of cast iron bolted together. These tunnels are inter-connected at several points by "cross-overs," which greatly increase the difficulties of ventilation. The tunnels are at a depth below the street surface varying from 60 to 100 feet, with 13 underground stations.

The Ozonair system of ventilation consists briefly in drawing the air supply from as clean and pure a source as possible, and removing the smuts and other solid floating matter by means of special filtering screens. During this operation practically the whole of the sulphurous acid and other deleterious gases are absorbed. The cleaned air is then passed into a mixing chamber, where it is purified and partially sterilized by means of ozone. It is also enriched by the addition of a minute quantity of pure ozone. From the chamber it is distributed by means of ducts, etc. Included in the system is the provision at will of a heating or cooling coil, to be placed in the mixing chamber or other convenient position. The manner of distribution is worked out on its particular requirements, and the number of changes of air are calculated according to the the nature of the special circumstances of the case. Draughts are avoided, and the amount of air, and also the strength of the added ozone, can be adjusted at will; so that the atmosphere can be varied according to the temperature or state of the barometer.

In the Central London Railway installation, the equipment consists of a separate and independent plant at each station, with the exception of Shepherd's Bush, which is near the open end of the tunnel. The pattern of generator supplied in this case consists of a series of 10 generating units, each comprising a thin mica plate with a sheet of metallic guaze on either side, the set of ten plates being spaced and mounted on insulating supports. The gauze sheets are connected across the secondary of a small transformer delivering alternating current at a pressure of several thousand volts, and an innumerable number of minute discharges occur all over the opposing surfaces of the plates. Most of the equipments each pass normally some 360,000 cubic feet of air per hour, and the generator provides an amount of ozone sufficient to preserve the proper proportion. The proportion of ozone and the volume of air supplied can be regulated from the switchboards controlling each equipment. The main ventilating fans are of the "Sirocco" pattern and are driven in most cases by 7½-horse power motors. The ozone generator is supplied with current at 5,000 volts from a transformer fed at 380 volts A. C. from a small 550 volt rotary converter.

Many difficulties had to be overcome in the design of these rotary converters before they could be built to work satisfactorily, on account of their small size and high direct-current voltage, but the machines now in use are giving every satisfaction.

The equipments provided with 7½-horse power motors deliver from 5,500 to 6,500 cubic feet of air per minute, but the equipments at Holland Park and British Museum are designed to deliver the still larger quantity of 18,000 and 10,000 cubic feet per minute respectively, the former on account of there being no equipment at Shepherd's Bush. Altogether over 80,000,000 cubic feet of ozonized air are pumped into the tunnels every working day.



GAS COMPRESSORS, ST. LOUIS COUNTY GAS COMPANY.

HIGH PRESSURE GAS DISTRIBUTION AT ST. LOUIS, MO.

BY FRANK RICHARDS.

Here, in a recent installation of the St. Louis County Gas Co., St. Louis, Mo., is an example of the practical, established transmission of artificial gas at high pressure, and its direct delivery to consumers without the intervention of the district gas holder. There are gas holders of the familiar type at the gas-generating plant, where the pressure maintained is from 5 in. to 9 in. of water, the latter being the maximum pressure reached when the tank is full, and no other gas holders are required for the distribution system.

The compressors take the gas at this gas-works pressure and compress it to a maximum of 40 lb. gage. The pipes into which the compressed gas is delivered have a capacity of 20,000 cu. ft., and these constitute the entire storage for the gas after leaving the compressor. As a pressure of 10 lb. is sufficient for all purposes, the permissible range of pressures in this pipe system, about two atmospheres, allows fluctuations in the quantity of gas contained of about 40,000 cubic feet of low-pressure gas, although neither limit of pressure is actually reached in practice. The gas comes to the consumer at whatever may be the pressure in the pipes at the time, and then it passes through an individual pressure reducer, after which it is metered at the constant low pressure maintained.

This is not to be considered as in any respect an experiment, at least with this company, as they have been following this system of distribution for some years, and find that it not only gives satisfaction to all, but that it pays well. They have never experienced any trouble from deposits of any kind in the pipes and the gas is found to be practically as rich after compression and transmission as before. There also has been found no trouble or danger from the heating of the gas in the compressing operation, and there has been no accident of any kind.

In Fig. 1 we have a view of the interior of the compressor room. In one corner of this room, but not seen in this picture, is apparently a vertical receiver, the familiar accompaniment of the air compressor, but in this case it is instead a tar extractor through which the gas passes before entering the com-

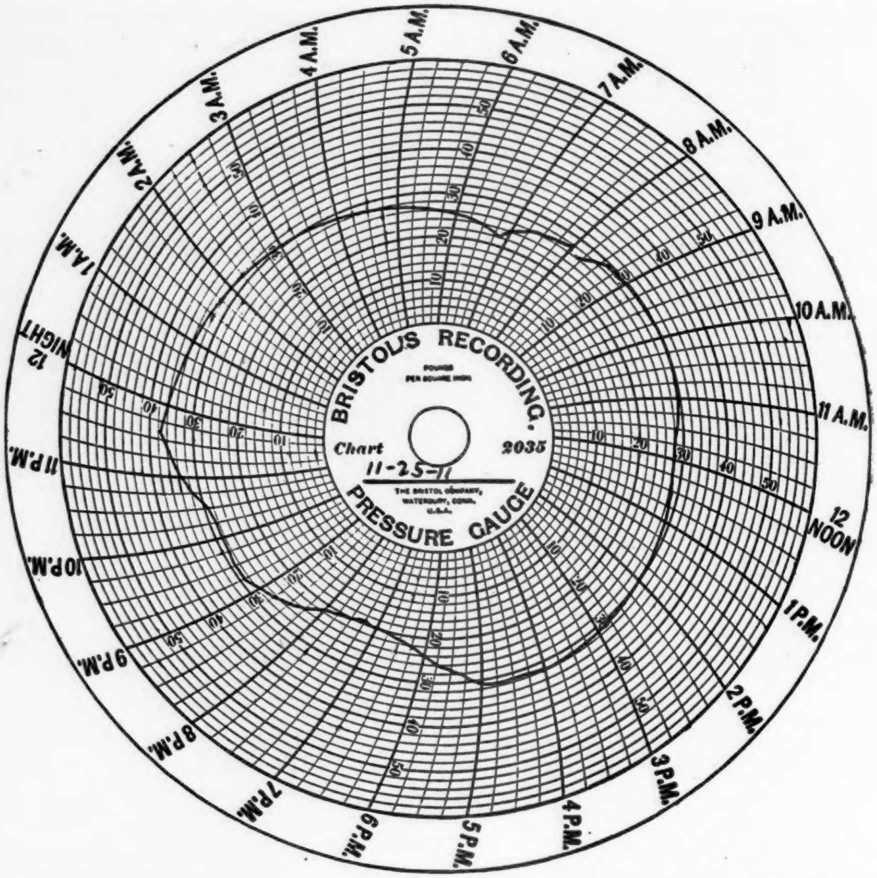


CHART RECORD OF GAGE PRESSURES IN AN 8-IN. GAS MAIN AT ST. LOUIS, MO.

pressors. These machines are two duplex gas compressors (Ingersoll-Rand, Class O) with cross-compound steam cylinders 12 in. and 23 in. diameter and duplex tandem gas cylinders 17¼ in. diameter with a common stroke of 18 in. and a normal speed of 120 r.p.m. The gas cylinders are, of course, completely water-jacketed. The mean horsepower is about 120 and the gas compressing capacity, with liberal allowances, about 1,500,000 cu. ft. per 24 hours. This approximates the present producing capacity, but considerably exceeds the consumption.

The compression of the gas under the conditions here presented is a very simple, or, as we might say, a very comfortable job for the compressors. The piston inlet furnishes an ideal means for connecting the intake, and the only automatic control required is a speed regulator, as on a stationary engine. This can easily be adjusted for different speeds according to the rate of gas consumption.

The gas is delivered into an 8-in. main, from which there are branches or continuations of 6-in., 4-in., 2-in., and 1½-in. pipes, the aggregate length of which may be inferred from the fact that the area served is about 120 sq. miles. The present number of customers is 6000, which number is being increased as fast as the pipes can be laid, the present daily output of gas being approximately 500,000 cu. ft. Only one of the two compressors is as yet required, and this is run 16 hours a day.

Fig. 2 is an accurate reproduction of a 24 hour record from the recording pressure gage, located near the beginning of the 8-in. pipe line. This record reads from 8 a. m., Nov. 25, to 8 a. m., Nov. 26, 1911. The record line coincides almost exactly with that of another gage 2¼ miles away, thus assuring us how lit-

tle loss of pressure there is in this transmission of over two miles, and suggesting that the same pipe may easily transmit twice or three times the present volume of gas.

The record line of the pressure-gage chart tells its story very clearly. The record begins a little after 8 a. m., and at 9 a. m. everything is running smoothly, the output of the compressor evidently keeping pace very closely with the eight mid-day hours to 5 p. m., a slight loss of pressure appearing about noon, when we may assume that some extra gas is used for cooking purposes. At 5 p. m. the demand for both lighting and cooking causes the pressure to fall quite rapidly for the next two hours. This is when the 'peak" load occurs, the peak being represented on the diagram by a depression.

Before 7.30 p. m. the compressor output has caught up with the consumption. Then the pressure rises gradually until 9.15 and is nearly stationary until 10.15, when there is a rapid rise until 11.30. The upper working limit is nearly reached here and the compressor is stopped, as indicated by the sharp angle at 11.35. From this point until 6.50 a. m. the compressed gas in the pipes is sufficient to supply the demand. The drop is very rapid after 6 a. m., but after the compressor is started the line rises easily before 9 a. m. to the normal day working pressure of about 30 lb. The pressure where the record ends at 8 a. m. seems to be about 2 lb. higher than on the preceding day; perfect coincidence, of course, was not to be expected.

The system of high-pressure gas distribution is constantly extending, both in this country and in Europe, and entirely upon a business basis. It is found that the cost for installation, operation and maintenance of compressor and high-pressure piping is less than that of the much larger low-pressure pipes, the district gas holders and the land actually required, to say nothing of the depreciated land values which the community has to stand in the vicinity of gas holders.

The plant here spoken of is a comparatively small one. That the principle it embodies is practically applicable to much larger service is self-evident. That it is not applicable and that it will not eventually be applied to all gas service, however vast or concentrated, I am not asserting.—*Engineering News.*

CHEMISTRY AND THE ATMOSPHERE*

We live immersed in an ocean of air and we draw this air into our lungs approximately eighteen times a minute. The quality of this air, its temperature, pressure, humidity, the minute impurities which may be present, affect our comfort and well-being in many ways. It supports the chemical processes of combustion by which our existence is maintained no less than those upon which we are chiefly dependent for light and heat and power. The nature of this all-enveloping atmosphere of air has always been a subject of speculation, though to little purpose before the advent of chemistry.

Modern chemistry had its birth in the eighteenth century study of the air and its relation to the processes of respiration and combustion. Professor Ramsay has said that 'To tell the story of the development of men's ideas regarding the nature of atmospheric air is in great part to write a history of chemistry and physics." The story is one which has reached its culminating interest in our own most recent times. For $35 you may now buy apparatus for reducing air to the liquid form and study the properties of matter at temperatures nearly as low as that of interstellar space.

Within the memory of the youngest undergraduate in chemistry the brilliant researches of Ramsay, Raleigh and other chemists have disclosed the presence in the air we breathe of five new gases of remarkable and in some respects unique properties. To one of these, neon, we now confidently attribute the long mysterious phenomena of the aurora borealis. Tubes containing highly rarefied neon may become as commonplace to our descendants as candles were to our forefathers. They glow with a rich, mellow, golden light on the passage through them of an electrical discharge.

The heavy toll of life in mine disasters would be unsupportably heavier were it not for the Davy lamp, the firedamp indicators, the rescue outfits and the regulation of explosives, all of which have become possible only through the growth of chemical knowledge. Ventilating systems as applied to theatres, halls and dwellings are based on chemical studies of the rates and causes of increase in the carbonic acid content in the air of rooms.

---

*From *The Earning Power of Chemistry,* by Arthur D. Little, Boston.

The proportion of sulphur permissible by law in illuminating gas finds its justification in similar studies on the air in rooms in which such sulphur-bearing gas is burned.

One of the most insistent of the demands of growing plants is that for nitrogen in form available for plant food. A small proportion of the necessary supply of nitrogen in the assimilative form is derived from the manure of farm animals and from animal wastes of various kinds, but for many years the world has depended upon the nitrate beds of Chili as the chief source of this indispensable element of plant growth. It is bad enough to be tied in this way to a single far-away deposit, but the situation becomes alarming when we discover that this deposit can hardly meet the world's demand for nitrate for another twenty years. One may contemplate the Malthusian theory with indifference or even with disbelief, but here is a condition not to be gainsaid. The world must do something to meet it within twenty years or the world must make up its mind to starve. Fortunately for the world the chemists are already doing something. They have recognized that 33,800 tons of nitrogen are pressing down upon every acre of land and have boldly attacked the problem of rendering available such portion of this inexhaustible supply as the world may need. The methods employed have been daring and brilliant in the extreme.

In 1785 Cavendish in a paper before the Royal Society describes the production of nitric acid by the passage of an electric spark through air. A hundred years later Bradley and Lovejoy at Niagara Falls, by drawing air through an apparatus by which 400,000 arcs were made and broken each minute, demonstrated the possibility of the commercial manufacture of nitrates from atmospheric air. Birkeland and Eyde in Norway pass the air through furnaces in which it comes in contact with enormous flaming and rotating arcs. Rossi in Italy brings the air in contact with highly incandescent material of special composition. Although by these several processes nitrate has been produced by thousands of tons it is doubtful if the artificial product can yet compete with Chili niter. Even now, however, the margin is not a wide one and the results already accomplished amply prove that when our agriculture begins to feel the pinch of a failing nitrate supply the chemist may safely be relied on to meet the situation. This assurance is rendered doubly sure by the fact that a solution of the problem along altogether different lines is already nearly or quite within our hands. Dr. Frank has shown that by heating calcium carbide, itself a comparatively recent product of the laboratory, in a stream of nitrogen there is formed a new compound, calcium cyanamide. The practical interest in this compound depends upon the fact that when exposed to a current of steam it decomposes into ammonia and carbonate of lime and that the same reaction takes place slowly in the soil when the cyanamide is mixed therewith. Since the nitrogen in ammonia is directly assimilable by plants and since calcium carbide requires for its production only lime and coke and power we may view without serious concern the approaching failure of the Chilian nitrate beds.

COMPRESSED AIR FOR RAISING WATER

BY FRANK RICHARDS.

One of the most obvious uses of compressed air is that of raising and conveying water and other liquids, and this has also become one of its most extensive fields of employment. The variety of ways in which the air is applied for this purpose and the diversity of the apparatus that has been devised are astonishing. While many have nothing more than a historic interest; the actual, practical ways in which air now is employed for pumping, while differing widely from each other in efficiency and other particulars, are not numerous, yet they would be none the worse for still further elimination. The conditions under which the water is to be raised largely determine the specific device employed in the individual case, but sometimes other considerations not so defensible prevail in the selection or in the retention of deservedly obsolescent systems.

There is, according to the system adopted, much difference in the amount of air consumed as compared with the work done, but in all cases the former must be in excess of the theoretical requirement, as nothing can be done for nothing. With our present knowledge, it still pays in many cases to use air for raising water, in both small and large quantities, and as a means of permanent supply as well as in temporary or emergent cases.

It is desirable not only to do but also to know that we are doing the work as cheaply as possible. Our present facilities make the met-

ering of water lifted or transferred an easy thing to do, and the raising of water, by compressed air or otherwise, can always be gaged with satisfactory accuracy, while records of such work are constantly accumulating and are accessible as guides to the engineer.

The theoretical horsepower required for raising water is

$$\frac{\textit{Pounds of water per min.} \times \textit{height of lift in ft}}{33{,}000}$$

The accompanying table may be taken as a starter; it furnishes the essential data as to the power required for raising water to different heights. It gives also the actual potential energy in the water so elevated, or the power which it should be theoretically possible for the water to develop in its descent to normal level if employed in a water-wheel or motor. When the power actually consumed in a water-raising operation is ascertained it can be compared with this table and the result will be an indication of the efficiency in the given example.

The first column gives the number of gallons of water lifted; column 2 gives the volume in cubic feet of the given number of gallons, while column 3 gives the weight in pounds of the same quantity of water. Column 4, assuming that the given quantity of water—gallons, cubic feet or pounds—is raised to a height of 100 ft. in a minute, gives the horsepower theoretically required for the lift, or the horsepower which should be developed by the descent of the water to its original level. Any other figures or quantities not in the table will be in direct proportion to those given.

TABLE OF STATIC WATER POTENTIALS

1	2	3	4	1	2	3	4
Gal.	Volume, Cu.Ft.	Weight, Lb.	Potential Hp. in Water Raised 100 Ft.	Gal.	Volume, Cu.Ft.	Weight, Lb.	Potential Hp. in Water Raised 100 Ft.
1	0.13368	8.355	0.025303	200	26.736	1671	5.0606
2	0.26736	16.710	0.050606	250	33.420	2089	6.3257
3	0.40104	25.065	0.075909	300	40.104	2506	7.5909
4	0.53472	33.420	0.101212	350	46.788	2924	8.8560
5	0.66840	41.775	0.126515	400	53.472	3342	10.1212
6	0.80208	50.130	0.151818	450	60.156	3760	11.3863
7	0.93576	58.485	0.177121	500	66.840	4177	12.6515
7.48	1	62.5	0.18928	550	73.524	4595	13.9166
8	1.06944	66.840	0.202424	600	80.208	5013	15.1818
9	1.20312	75.195	0.227727	650	86.892	5431	16.4469
10	1.3368	83.55	0.25303	700	93.576	5848	17.7121
20	2.6736	167.10	0.50606	750	100.260	6266	18.9772
25	3.342	208.87	0.63257	800	106.944	6684	20.2424
50	6.684	417.75	1.26515	850	113.628	7102	21.5075
75	10.026	626.62	1.89771	900	120.312	7519	22.7727
100	13.368	835.50	2.5303	950	126.996	7937	24.0378
150	20.052	1253	3.7954	1000	133.680	8355	25.303

DRIVING STEAM PUMPS WITH AIR.

First of all (as an example of "how not to do it") consider what it costs to drive an ordinary, direct-acting steam pump by compressed air. It is often so convenient to do this, in mines, tunnels, excavations for foundations and elsewhere, that it is done generally without counting the cost, either before or after.

The simplest case is where the steam or air and the water cylinders are of the same diameter, and have the same stroke. Here if there were no allowances to be made for clearance losses, leakages, power required to overcome friction and inertia, and if it had cost nothing to compress and transmit the air—all these and other things being those which pure theory is so apt to belittle or ignore—the volume of air at the balancing pressure would just equal the volume of water delivered and the efficiency would be 100 per cent.

The standards of efficiency which we call the possible efficiencies are really the impossible efficiencies. It is well known that they can never be attained, and very far from it in the present case. The air pressure must be enough in excess of the water pressure to overcome the frictional resistance of the machine itself and of the water in contact with the surfaces in its restricted flow through valves and passages, and to give and maintain sufficient impulse in the otherwise inert column. For all this it will be proper to allow an initial deficiency in the air power at the pump which will average not less than 20 per cent., and the

100 per cent. efficiency with which the author started is reduced to 80 per cent.

But if there is such a deficiency, the pump will not go. This is understood; and the several deficiencies are anticipated and provided for beforehand by furnishing air in sufficient volume and at an excess of pressure to overcome them.

To run a pump comfortably the working pressure of the motor fluid should be somewhat above the actual requirement, but it is not necessary to speak of that here as affecting the power consumption.

Next, the matter of cylinder clearance may be considered, which is interesting in the direct-acting steam pump at any time, and especially so when the pump is driven by air. Nothing need be said about clearance losses in the water cylinder, for practically there are none, as all the spaces may usually be assumed to be filled solidly with water, and if everything is in good order all of the actual travel of the water piston is represented by water delivered.

Enough clearance losses in the air cylinder may be found to satisfy for both. The direct-acting pump has no crank to bring the piston to a dead stop always at the same point at the end of the stroke, and, as at the same time it must be certain that the piston shall never strike the head, very large clearance is provided. The filling of this large clearance, together with that of the unavoidable clearance spaces in the passages between the valves and the cylinder, entails another large excess of air over that theoretically required, or a deficiency of work done as compared with the air consumed of, say, another 20 per cent. This percentage of 80 being 16, 64 per cent. of the original 100 at this point is left.

There is a third great loss of efficiency when compressed air is used to drive a direct-acting steam pump because the air is used at full pressure and shows none of the advantages of being used expansively. If, instead of using the air at its highest pressure to fill the cylinder to the very end of the pumping stroke, it could have been used in a crank-and-flywheel pump, or in one of any other design in which the air could have been cut off at the proper point of the stroke, so that it would have been discharged at a pressure nearly that of the atmosphere, then the work done for the quantity of air used would have been, on the average, varying with the initial pressure of the air, say, 50 per cent. more than without the cutoff and expansion. That is, it could and would have done one-half more work, and the failure to do this amounts to another deficiency of one-third, or, say, 33 per cent. This percentage of 64 being 21, there is left only 43 per cent. of the original 100, and this diminution of efficiency is all realized after the air has arrived at the pump and without looking to the losses which have accumulated previous to its arrival on the job.

NOT TO BE CHARGED TO THE AIR.

Now, the curious thing is that not one of the losses here mentioned, nor any portion of any of them, is in any way chargeable to compressed air. They all inhere in the apparatus and in the system by which the air is applied to the work of lifting the water.

One loss peculiar to steam and entirely absent with air is the loss by condensation, concerning which it is not necessary to present any figures. It is plain that the air should not be blamed for any of the losses of which it becomes the agent when driving the steam pump.

Thus far, the direct-acting pump alone and its deficiencies or those which it entails, have been considered. Of course, the pump has nothing to do with the friction losses in transmission from the compressor to the pump. For all such losses and for all possible leakages allow, say, 5 per cent., deducting which from the 43 per cent., found above, leaves 41 per cent., all the rest having disappeared after the air left the compressor. The transmission loss just allowed would be greater with steam, while some of the distances which air may be carried are prohibitive with steam.

While the cost of compressing the air used is not considered, attention might be called to the approximate figures for compressing free air to, say, 80 lb., gage. Assuming a steam-driven, reciprocating air compressor and both compressor and pump to run regularly under their respective rated loads, the power which is being developed in the steam cylinder may be taken as a starting point or the basis of efficiencies First must be deducted a sufficient allowance for the friction of the entire machine and for the leakage and clearance and

other air-cylinder losses, amounting altogether to an inefficiency of at least 20 per cent., leaving 80 per cent. Then in the compression of the air the excess of power required for the actual adiabatic compression, instead of the theoretical isothermal compression, will be 34 per cent. This percentage of 80 being 27, the surviving efficiency will be 53 per cent. This being the efficiency of the compressor and 41 per cent. the pump efficiency, the ultimate efficiency of the combination is 21.73 per cent.; that it, it will take about 5 hp. in the steam cylinder of the compressor to realize 1 hp. in the actual lifting and delivery of the water. Actual results are seldom any better, and often much worse, than this in practice.

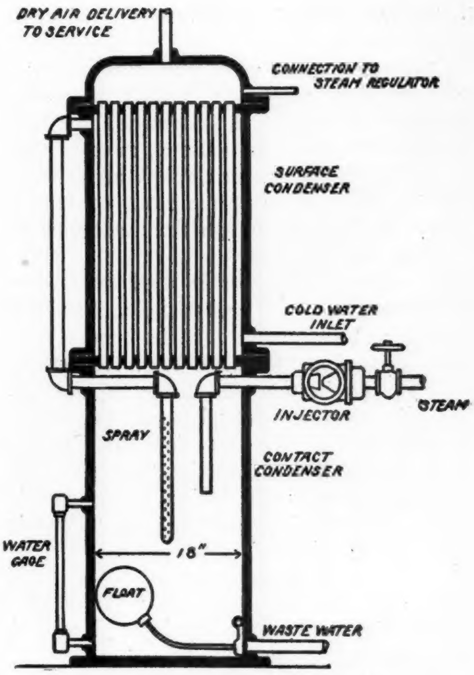
At least one hint may be taken from these figures, which is that the loss is the least where the working air pressure is the lowest. In the case of the direct-acting pump the difference may be made in the relative capacities of the air (driving) and the water (driven) cylinders, and, in general, the larger the former is, the better. Thus, supposing the air to be used at 40 lb., gage, instead of 80, the excess of mean effective resistance in the air compressing cylinder in the act of compression would be only 22 per cent. instead of 34, and the loss in the air cylinder of the pump through not using the air expansively, would be relatively the same, so that there would be a saving at both ends.

DIRECT STEAM FOR AIR COMPRESSION

The sketch here reproduced from the Louisiana Planter shows a novel type of air compressor which is finding special employment in the sugar industry. It furnishes comparatively dry air for such purposes as ventilation, for mixing liquids in tanks (as in blending water with molasses), keeping liming tanks stirred and giving the low pressure blast needed for vaporizing sulphur burners.

An installation of this kind is now giving satisfaction in stirring water into high-density liquor to bring the product to standard density, blending a volume of about 10,000 gallons perfectly in about twenty minutes.

Essentially the principle is the use of steam in a special injector nozzle to drive air into a storage chamber, this chamber being provided with a water-spray which condenses and removes the steam that passes along with the air. A small jet of steam ⅛-inch to 3-16-inch nozzle—and a very small water consumption give a remarkably large volume of air at pressures ranging up to 15 pounds gage, and dry enough to use for the combustion of sulfur without forming excess of sulfuric acid.



DIRECT STEAM AIR COMPRESSION.

There are no moving parts whatever excepting the float, and the apparatus is thus as simple and dependable as a steam trap, and requires as little care or operating expense. The cost as compared with mechanical air-compressors gives this device all the advantage, since it is always ready to run as soon as steam is turned into it; needs no oil or packing, nor tightening of stuffing-boxes, has no wearing parts, and can be set for any desired amount or pressure within its range by the steam admission valve, and a steam regulator valve can be used to control the pressure.

Reference to the illustration shows the injector with its steam connection forcing steam and air into the contact (or direct) condenser cylinder, where the steam meets the spray of water and all disappears, the air continuing upwards into the tubed surface condenser where the cold surface removes practically all of the remaining moisture and cool, dry air

is delivered through the pipe at the top in to the service line.

Cold water, which must have sufficient head to overcome whatever air pressure the apparatus may be working at, is admitted first into the surface condenser shell and, after passing around the tubes, passes through an external pipe into the sprayer of the direct condenser, finally running off through the waste pipe to the boiler or elsewhere.

The surface condenser is used only when the air must be as dry as possible. For tank stirring and ventilating only the contact condenser is used and the cover cap fitted directly upon it. By heating the current of dry air, it can be used to great advantage for drying sugar as it passes the chute into the bins.

The apparatus is of cast-iron, excepting the copper float and the iron tubes. At 75 pounds steam pressure about 0.26 h. p. per hour is used for operating this compressor.

FLIES ARE NOT FRIENDS OF MAN

The Welfare Committee of the Iron and Steel Institute issues the following note of warning about flies:

Flies are a dangerous nuisance, they carry disease. People are just beginning to wake up to this fact. All flies are dangerous; house flies are especially so, because they are so numerous and because they come in contact with people and foods. A single family fly lays an average of 120 eggs at a time. Four deposits of eggs may be made by one fly. Under favorable conditions the eggs become flies in about ten days. It takes about ten days more before these flies also lay eggs. It can be readily seen how fast flies will multiply if they are not destroyed. They have no choice between the cleanest kitchen and unmentionable filth. Flies may infect foods with disease germs. They spread typhoid fever, as typhoid fever is a germ disease. Flies deposit typhoid germs in butter, milk and other foods—therefore, butter and milk should be kept covered and so should all other foods where possible. The germs deposited by flies are especially dangerous to infants and children. Flies like to feed around the eyes of sleeping children, and in so doing, may cause serious eye disease. Flies must be kept from entering dwellings; all windows should be screened. Foods should be kept screened and tables should not be kept continuously set.

DOUBLE VACUUM DIE CASTING

BY ETHAN VIALL.

One of the great difficulties encountered by makers of die castings has been the liability of the castings to be porous or full of air holes at the place where least desired. These blowholes have been caused by air being confined in the mold when the melted metal entered it.

The general practice has been to exhaust the air as much as possible from the mold just previous to letting in the metal, but the vacuum created in the mold has caused some of the metal to spray into the mold from the melting pot, which metal seals up to a greater or less extent the vents of the mold. Then when the metal for the casting was forced in, there was air in the mold which had no place to get out, or if there was an opening for it, it was too small to let the air out fast enough and blow-holes were the inevitable result.

In fact, considering the speed at which the metal for the casting is forced in, an opening almost as large as the gate itself would be needed to let the air out fast enough to prevent bubbling, in which case no vacuum of any description could be maintained.

In order to overcome the difficulties just mentioned, C. M. Grey, of the C. M. Grey Manufacturing Co., East Orange, N. J., some time ago invented a machine in which a double vacuum is used; a vacuum in the die and a vacuum back of the melted metal.

The two vacuums are evenly balanced up to the instant of filling the die, when the metal is forced in by compressed air, this plan preventing the "leakage" of air into the die, and consequently there is nothing in it to cause blowholes when metal is cast in.

THE CASTING MACHINES.

In order that the reader may have a clear idea of how this is done, we will proceed to illustrate and describe the casting machines in detail.

A view of an individual machine is shown in Fig. 1, in which *A* is a die set into a carrier which may be swung back when the die is to be opened for the removal of the casting; *B* is the lever which operates the lock used to hold the die carrier firmly down onto the top of the metal tank; *C* is the handwheel by which the operator governs the vacuum and air vales; *D* is a vent pipe for the products of combustion; *E* is the pipe to the gas heater

used to melt the metal, and *F* are exhaust tubes connected to the die through which the air is pumped out.

Referring to the opposite side of the same machine, Fig. 2, the letters correspond, but with the addition *G*, which is the lever used to open the die; *H* operates the gate; *I* works the mandrel in a threaded part of the casting made in this die, and also forces out the ejector pins; *J* is the valve box; *K* is the vacuum gage and *L* is a vacuum equalizer containing a metal diaphragm, which is connected to valves leading to the vacuum pipes for both the die and the metal pot.

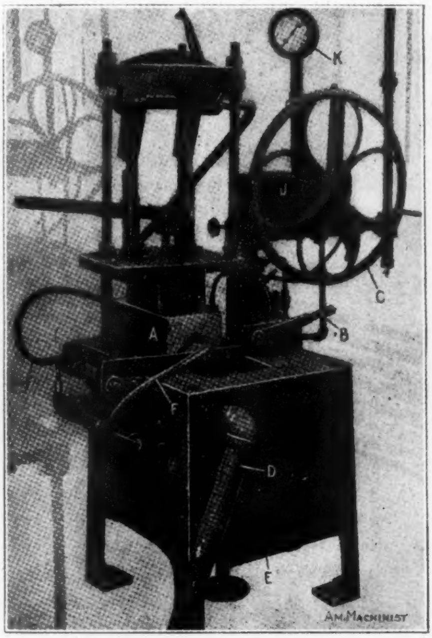


FIG. 1.

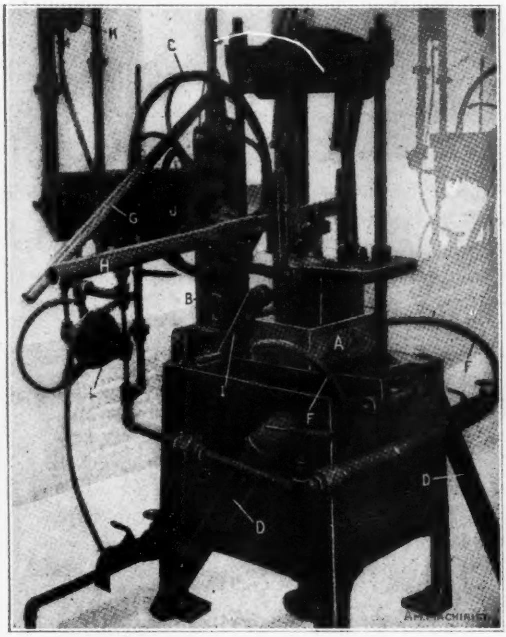


FIG. 2.

As the vacuum gains on one side, the diaphragm is pulled over; this opens the valve on the opposite side a little wider and allows the vacuum to increase, and *vice versa*, the action of the diaphragm automatically keeping up until the desired vacuum is attained equally on each side. The arrangement of the die and metal pot will be gone into in detail further along in this article.

One of the machines open, with the parts of the die separated, is shown in Fig. 3. The die carrier is counter-balanced by a cord and weight to make it easier to handle, and when thrown back rests on a wooden support, as shown.

The die shown here is different from the one illustrated in Figs. 1 and 2; the lower part is shown at *A*, the upper part being drawn back at *B* by swinging around the lever *C*. A part of the vacuum chamber for the metal pot is shown at *D*; *E* is the opposite end or spout of the pot, through which the melted metal enters the die when the carrier is in position; *F* is the supply tank from which the metal pot is replenished as the castings are made, the metal simply being dipped with a ladle from the supply tank and poured into the spout.

DETAILS OF THE DOUBLE VACUUM.

The line engraving, Fig. 4, shows the method of obtaining a vacuum back of the metal to be cast, at the same time a vacuum is obtained in the die. This engraving was taken from the patent specification, and while not exactly the same as the plan of the machines photographed, it serves to make plain the principles of the apparatus.

In this, *A* and *B* represent the two parts of the die body, and *C* the die cavity, shaped to form the casting desired; *D* and. *E* are vents

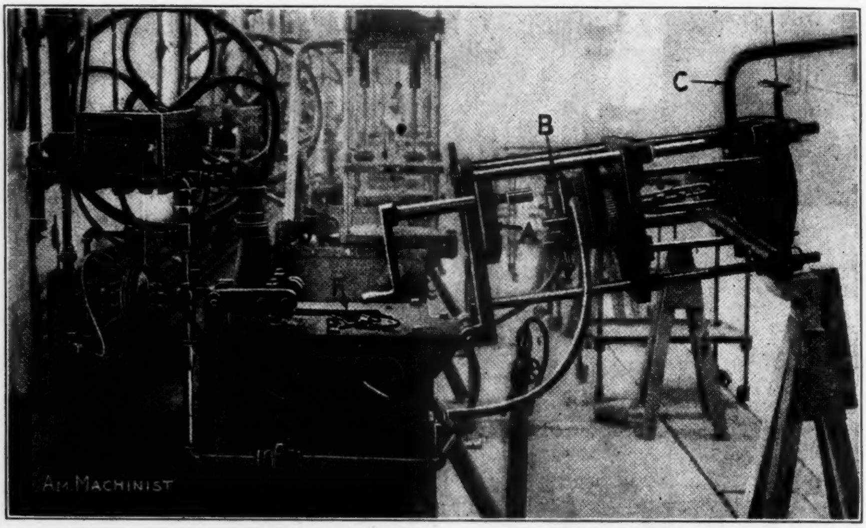


FIG. 3.

through which the air is exhausted from the die through the pipe *F*; *G* is the gate of the die which rests directly over the spout *H* of the metal pot *I*.

In actual practice there is a valve or plunger used to close the gate and shut off the melted metal after the die is full. The operation of this is familiar to die-casting operators, though not shown here.

At the end of the metal pot, opposite the spout, is a vacuum chamber *J*, to which the pipe *L* is connected. This pipe not only connects with the vacuum pump at *M*, but also to the compressed-air pipe at *N*. The exhaust pipe *O* has two branches, *P* and *R*, which lead to the vacuum chamber of the pot and the die, respectively, through the valves shown in each branch.

The pipes *S* and *T* lead from the two exhaust pipes above the valves to chambers on opposite sides of the diaphragm *U*, so that excess of vacuum in either the metal pot or the die will cause the diaphragm to move toward the side on which the vacuum is greatest, partly closing the valve on that side and correspondingly opening the valve on the opposite side. In this way an equal vacuum is obtained on both sides of the melted metal and pre-

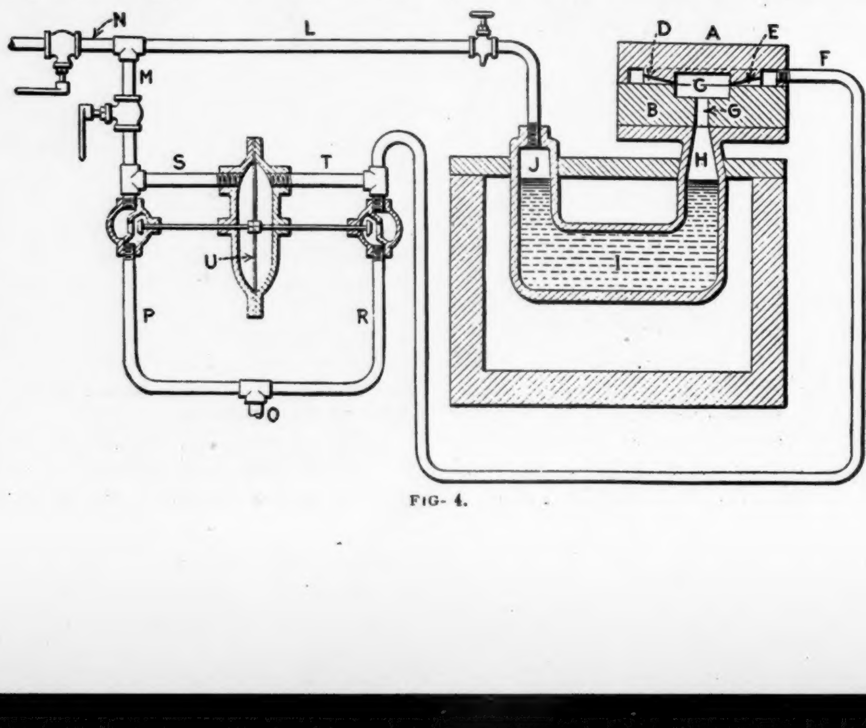


FIG. 4.

vents the entry of air, gas or melted metal into the die, without the interposition of mechanical means.

When the balanced vacuum has reached the desired amount, as indicated by the gage, the suction is shut off at *M* and compressed air is instantly let in at *N*, which goes through the pipe *L* and forces the melted metal up into the die.

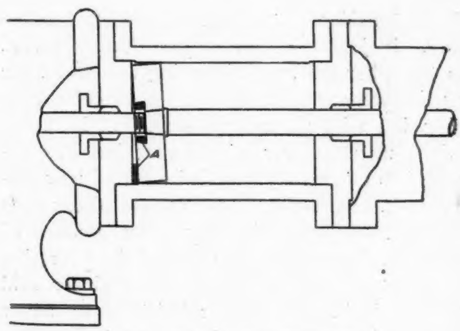
The method of employing a vacuum on both sides of the melted metal previous to casting, effectually prevents porousness or blow-holes in the castings.—Condensed from *American Machinist*.

REFINEMENT IN COMPRESSOR CONSTRUCTION—AND THE TROUBLE IT CAUSED

The compressor was of the 2-stage type, with duplex steam cylinders and was known as a 10 and 10 by 16 and 10 by 10 compressor. The 10 by 10 steam cylinders were attached to the main frames with the air cylinders arranged tandem behind them, with a short distance piece between. Steam and air piston heads were held on the piston rod by means of a taper fit, with a recess, slightly reverse-tapered, as shown in the cut, in each head, into which fitted the nut which held the piston head in place.

The piston rod was 2 in. in diameter at the air end, but only 1¾ in. at the steam end. In order to get the steam piston head on the rod, it was slipped over the rod from the crosshead end and fastened with the nut and *the space around the nut filled in with babbit, so as to reduce the clearance* as much as possible. And this was where the weak point occurred. The recess in the steam piston did not have taper enough to hold the babbit and examination showed that possibly the core fell away in casting the head, so that the metal had to be bored out, leaving the inside of the recess so smooth that it would not hold the babbit.

After the machine had been in operation about 2 months, suddenly one day the compressor, while running about 35 r.p.m., stopped and investigation showed that the crank on the second stage side was on the center and that it required 3 men with a lever 16 ft long to move the wheel. When started, the machine showed considerable distress, but as air was needed badly the engineer was instructed to keep the compressor in operation for the rest of the day, if possible.



THE BABBITT DROPPED OUT.

Two hours later, the machine gradually slowed up and stopped and no amount of skill could move it. The distance piece was taken off the side that showed lame and the back steam cylinder head removed; the top and bottom of the inside showed that there was an enormous pressure there. A small try square was inserted and the piston head was seen to be out of square fully $^3/_{16}$ in. on the diameter.

It was then a matter of learning the cause of this effect. Believing that the cause was on the other side of the piston, but not knowing just what it was, the engineer disconnected the piping and removing the bolts, slipped the steam cylinder back off the front head and there he found the trouble. The babbitt had cracked radially from the corners of the jamb nut and a sixth of it had worked out and dropped into the clearance space at A and when that crank had crossed the center, this piece of babbit, which was about ⅞ in. square by about 1¼ in. long, was squeezed up to about $^3/_{16}$ in. thick and 2 by 3 in. in general dimensions.

One piece having dropped out, the other five were quite loose and although they were hard to remove in the limited space it was not thought best to leave them in, so by means of two blow torches the remainder of the babbit was melted out, when the jamb nut was set up tight and locked with a round nose chisel. While in this position, it was learned for a certainty that the piston rod was sprung so much as to throw the piston head out of square as shown, and the edges of the piston head rubbing on the walls of the cylinder were what caused the excessive friction.

The compressor was assembled and again put in operation and, by using plenty of cylinder oil and graphite, friction was gradually re-

duced considerable, and air supplied to the factory. In just a week the same thing occurred to the other side, and, knowing the cause, the repairs were soon made and the machine running, but with an enormous friction load.

The manufacturer of the machine was appealed to and finally supplied a set of new piston rods. Replacing of the sprung piston rods was not attended with any great amount of pleasure, but when once placed in operation (without the babbit filling) the engineer said that he had a peace of mind that he never knew before.—Condensed from *Practical Engineer.*

CONGRATULATORY REMINISCENCE OF COLLEGE AND MANUFACTORY

[Abstract of the address of F. A. Halsey, M. E., at the dedication of Rand Memorial Hall, Sibley College, Cornell University, Ithaca, N. Y.]

To a Sibley alumnus of the early days, this occasion is primarily one of reminiscence. My thoughts go back to the time when technical education was a new and untried thing, and not only new and untried, but looked upon with skepticism and even aversion, when the Sibley shop and its students in overalls were objects of amused interest to academic visitors, whose educational horizon took in nothing beyond a classical education, men, who could see no value in systematic training for careers similar to their own.

Those of us who formed the early classes in Sibley know better than those of to-day can ever know, the scant sympathy with which this educational movement was received. The graduate of to-day may not always find the door of employment wide open for him, but he is at least spared the supercilious air of superiority with which the proffer of the services of the early graduate was too often rejected.

No retrospect of this kind can fail to compare the feeble beginnings of this movement with its present noble stature, and the building that we are here to dedicate supplies a gauge of progress which all can see. This is to be a shop building and we have but to compare it with the Sibley shop of the 70's. That early shop was housed in the west room of the first floor of what we must now call the original Sibley building, and I am bound to say that, even in those seemingly narrow quarters, there was no crowding, either of equipment or of students. Small as the quarters were, I distinctly remember that there was room for more than came.

By excellent authority we are told to despise not the day of small things, and the student who imagines that more earnest work is being done on this campus to-day than was done here thirty-five years ago, needs to have that impression corrected. Perhaps I can give my own appreciation and estimate of that work no better than by repeating what I said to the students at Columbia last winter, that they were going to get a lot of second hand teaching handed down from Professor Sweet; and I am bound to say that of what they got from me, the best was that same second hand assortment.

This building is to stand as a memorial to the brothers, Jasper R. and Addison C. Rand, and Jasper R. Rand, Jr., and because of my association in business with these brothers, I have been asked to say something about their personalities and their work.

Someone has said that the only way to know a man is to work for him. If this be true, I ought to have known these brothers, for I was in their service for a period of twenty years—fifteen years actively, and five years more in a consulting capacity.

First let me say that they were *brothers,* by which I mean, not only sons of the same parents, but brothers in every best sense of that word. Associated in business throughout their business lives, the mutuality of their interests, their mutual forbearance, and their manifest mutual regard, was perhaps the most striking feature of their association.

Of them I knew the younger brother, Addison C., far better than the elder, Jasper R. The mechanical side of their business, which ultimately dominated, was the outgrowth of a previous business in high explosives. It was this older branch which was in charge of the elder brother, while the mechanical side with which I was exclusively connected, was in the hands of the younger brother. Moreover, for many of his late years, the elder brother was not in robust health, and this, with the growing predominance of the mechanical work, led to his gradual withdrawal from active management.

No one, however, who ever came in contact with Jasper R. Rand, can forget his genial

spirit, his ready wit, and his quickness for repartee.

Of the son I knew even less than of his father. During my active days at the office he was but a lad, and as he grew to manhood after I had gone elsewhere, I naturally saw but little of him. He was better known on this hill than I knew him, for he was a Sibley graduate. It is doubtless known here that on the outbreak of the war with Spain, he enlisted with the First New York Volunteer Engineers with whom he saw service in Porto Rico, where he contracted typhoid fever, from which, however, he happily recovered.

The death of his father and uncle placed heavy responsibilities on his young shoulders, which he was just beginning to learn to carry when his untimely death cut short a business career of greater promise and opportunity than any that I have ever personally known.

The work which these brothers did was, of course, the development of the rock drill and the air compressor, the latter at the beginning being essentially an adjunct of the former. The rock drill had its real beginning at the Hoosac Tunnel, which was driven by the Burleigh drill. Another, a still older brother, Albert T. Rand, had been the moving spirit in establishing the Laflin and Rand Powder Co., and to this company came plans for a rock drill intended as a competitor of the Burleigh, which was then the only commercial machine. Addison C. Rand's already demonstrated mechanical ability led his brother to turn the investigation of this machine over to him, and the result was a condemnation of it.

Knowing as we now do the requirements of these machines, it is easy to see that Mr. Rand's foresight was as sound as is our hindsight. The circumstances under which the later machine with which they became identified was brought to his attention I never knew, but the subsequent history of that machine and the magnificent business of which it was the foundation, show that Mr. Rand's judgment was as sound in accepting the one as in rejecting the other, and these two incidents point out his most striking characteristic, an unfailing judgment, and not only of things but of men.

It is, of course, the nature of education to glorify intellect, and perhaps, before this audience, I shall say an unpopular thing when I affirm that, as I see the affairs of men, it is not intellect that moves the world, but judgment: that quality, akin to instinct, which guides us when all rules fail, that knows what to do and what not to do, when to act, and when not to act; and it was this quality, which with one other, pre-eminently characterized Mr. Rand, that other being patience; limitless patience, willingness to wait, with faith in the outcome; and in the business which was being founded he had every need of both.

Perhaps no machine that ever came from the brain and hand of man is less indebted to the engineering practice of its time than the rock drill. It was only partly a matter of invention, though the inventive problems were serious enough. Behind all such problems, was the all pervading problem of material, and in the solution of this problem, less than no help was to be had. It was not that there were no guides. There were guides in plenty, but they all pointed in the wrong direction, and the more effort was made to do what prevailing practice said was right, the worse were the results.

The rock drill is, of course, primarily, a machine for resisting shock, with the added feature of portability. Minimum weight being essential, when parts break the rock drill designer is denied the common recourse of making them larger, his only recourse being to find a more suitable material. Moreover, in the early days, the solution was never complete, for in constant pursuit was the demon of high pressure. When the machines had been made to stand up fairly well, under 60 lbs. air pressure, the users promptly raised the pressure to 70 lbs., and then to 80 and to 90, and what figures have now been reached I do not know.

This problem of material was thus fundamental and, in solving it, all tradition had to be broken and "sound practice," as then understood, had to be discarded, because such practice was absolutely wrong, and in solving it the brothers Rand taught the engineering world a lesson that made it their lasting debtor.

The first lesson was learned on the piece called the rocker pin—a steel pin the size of one's little finger, and subject to repeated and violent shock. Formerly the operator would begin his day's work with a pocket full of these pins to replace those broken, expecting to bring back but few of them at the close of the day. The correct material was found

as the result of an aimless trial of every material that offered, the final selection being a special imported *high* carbon steel. No one had then the courage to suggest that the results were due to the high carbon percentage. They were believed to lie in some mysterious property of this special steel, and the lesson went no further.

I might detail other experiences of the same kind, but that would accomplish nothing. I cannot, however, give you an adequate idea of the situation while this condition lasted. Perhaps the most trying of all these experiences, was on the then new New York aqueduct, the second Croton aqueduct, where the piston rods began to break in wholesale manner as the rockers had done before. The aqueduct was divided into two sections, which were under different contractors, one section being equipped with Rand and the other with Ingersoll machinery. I doubt if there ever was a more keen and relentless rivalry than existed between these two companies at that time, and we had every reason to know that their piston rods did not break.

As a matter of fact, they were as full of trouble with compressors as we were with drills, but that we did not know, until too late to get even comfort, let alone compensating advantage.

All this is but to point out those qualities of judgment and of patience of which I have spoken, the former manifested here in breaking with a practice that had the sanction of every authority, for I well remember the keenness of Mr. Rand's analysis, in the face of everything published, when the accumulation of facts and experiences had gone far enough to point out the principle that lay beneath them, and the conclusion that in its precepts the engineering world was wrong.

This phase of his character I hope I have made reasonably clear, but the bearing of these experiences upon that other phase, his limitless patience, is beyond us. Only those who have been through similar experiences in founding a pioneer business can appreciate it. To bring back the business rivalry of the times, the manner in which this rivalry was utilized by impatient customers and by others, to whom stronger words might apply, to explain the load of anxiety to which all this led, and the unfaltering faith with which it was all carried, this I cannot do in any manner that seems worth attempting.

But it all had its reward in its ultimate success and in another outcome, which to both these brothers was, I believe, of greater value than business success. I mean the spirit of absolute loyalty and devotion on the part of their entire body of employees which I have never seen equalled and which, at the end, was rewarded in a manner that showed how profoundly it was appreciated.

And in view of it all, what an appropriate memorial this is! A building of lasting usefulness in the high cause of education; more specifically, a building for a school of engineering provided from funds accumulated in an engineering business; and more specifically still, a building for a university machine shop, provided from funds accumulated through the work of a machine shop. It seems to me that the donor has been singularly fortunate in her selection of a memorial and that those in whose name it stands could have made no better choice. Could they have foreseen this, as one of the outcomes of a life time of trial, it could only have been another recompense for those trials.

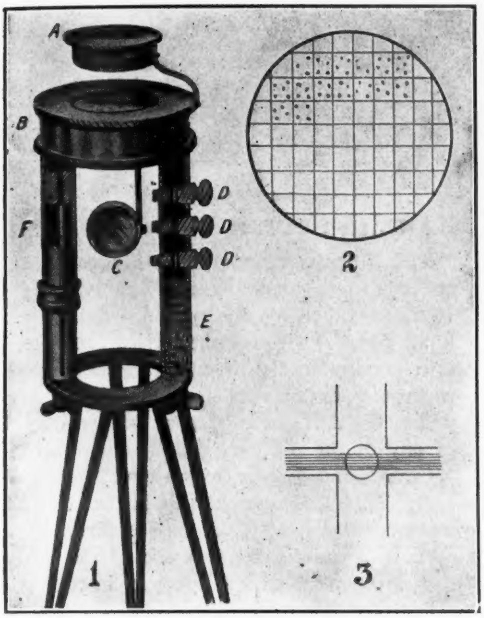
COUNTING THE DUST IN THE AIR

There are various methods of measuring the dust in the air. A known volume of air may be drawn through a filter of cotton wool, or bubbled through distilled water, and the dust detained by the cotton or deposited in the water may be weighed. Most forms of apparatus used in studying dust serve only to show the total weight per unit volume of air, or provide means of securing specimens for microscopic examination.

The majority of dust-particles, however, are ultra-microscopic, and it is a matter of much interest—especially in connection with the study of the condensation of atmospheric moisture—to determine the total number of particles, regardless of their weight, present in a unit volume of air at any time or place.

This is effected by means of Aitken's dust-counter, one of the several forms of which is shown in the accompanying illustration.

The instrument is shown, partly in section, at 1. *B* is a shallow circular metal box of known capacity, having glass plates at top and bottom. It stands upon two cylinders opening into it. The cylinder shown at *F* contains a piston, and serves as an air-pump. In the other cylinder there are three taps, *D D D*, the bores of which hold measured volumes of air.



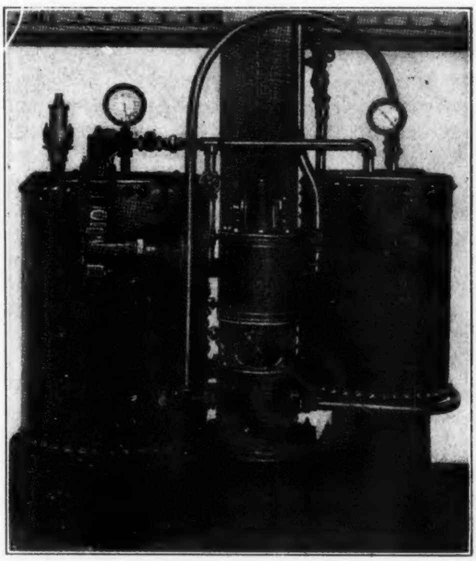
At the bottom of this cylinder there is a plug of cotton wool, beneath which there is a small hole through which the air may enter. At *A* is a magnifying glass, and at *C* a reflector, for illuminating the glass plate at the base of the box *B*. This plate is divided into measured squares, etched on the glass (shown at 2). The atmosphere within the box is kept saturated with moisture by means of strips of damp blotting paper.

The instrument is used in the following manner: The piston at *F* is drawn down, while the taps are in the position shown in the diagram. Air is drawn through the plug of cotton wool and thus enters the metal box free from dust. The instrument is now ready for testing a sample of air. One of the plugs is turned so as to communicate with the outside air, as shown at 3. It is then turned back, so that its bore again communicates with the metal box, into which a known volume of dusty air is thus admitted. One or two rapid strokes of the piston now serve to cool, by expansion, the air in the metal box; drops of moisture form and are deposited on the glass plate, where they may be counted. (See 2.)

Each of these drops is condensed about a particle of dust; hence the number of drops represents the number of dust particles. The latter may themselves be far too minute to be visible under the highest power of the microscope, but they reveal their presence by becoming the nuclei of condensation.

If the outside air were admitted freely to the metal box and the latter were then closed, the drops formed by sudden condensation would be far too numerous to count. However, by diluting a small volume of dusty air with a large volume of pure air, in the manner above described, the drops are easily counted; and it only remains to multiply the result by a factor corresponding to the degree of dilution to determine the dustiness of the outside air, expressed in the number of particles.

Aitken and others have made innumerable tests of the air in all parts of the world. The number of dust particles has been found to vary from a few thousand per cubic inch over the oceans and in mountain regions to 50,000,000 and upward in dusty towns. A room, near the ceiling, has been found to contain 88,000,000 to the cubic inch. Aitken tells us that a cigarette smoker sends some 4,000,000,000 particles into the air at every puff.—*Scientific American.*



A PNEUMATIC POP-SAFETY VALVE TESTER

The half-tone which we here reproduce from the American Machinist shows an outfit in use in the 'Frisco railroad shops, Springfield, Mo., for testing pop safety valves for locomotives. The air reservoir at the right is

connected to the shop air line, and its gage indicates the shop line pressure which is maintained at 90 lb. A connection with stop valve leads from this to the reservoir at the left and when this is filled to the shop pressure the valve is closed. Air is then admitted to the pump—an air brake pump always to be picked up in a railroad shop—and the pressure is pumped up to 240 lb. at which its safety valve is set.

The air gage on this reservoir is connected to a piece of 2-in. pipe 24 in. long, the lower end having a $^1/_{32}$ in. opening, leaving the pressure steady so that the needle of the gage is free from vibration while the pump is working. The operator can thus see exactly how many pounds the valve being tested will lose before popping.

The pop to be tested is fastened to a large gate valve on the front of the left-hand reservoir, various sizes of nipples being used for different makes and sizes.

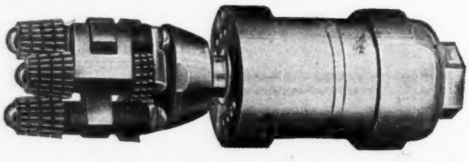


FIG. 1.

AN AIR DRIVEN TUBE CLEANER

The little half-tones on this page show a boiler cleaner made by the Lagonda Manufacturing Company, Springfield, Ohio. Fig. 1, is an external view of the device complete. It is essentially an air driven rotary motor which is geared to the group of toothed cutters which do the work. These cutters may be of any of the different types in use.

Figs. 2 and 3 will give a good idea of the construction and operation of the motor. The compressed air or steam passes through two ports in a plate in the rear end of the cleaner then through transverse openings in the rotor,

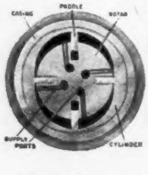


FIG. 2.

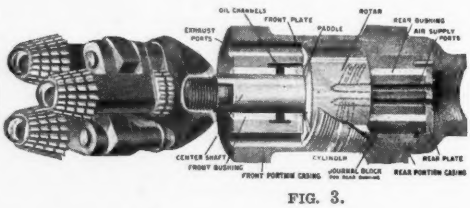


FIG. 3.

and out through branch openings to the space behind the paddles. There are only two ports opening into the air chamber, so that only the two paddles which at the moment are doing the work are under air pressure and there is no communication to the two idle paddles, and excessive leakage of air is thus avoided. After the air has done its work behind one of the paddles this paddle uncovers an exhaust port and the expanded air is allowed to pass out through the front end of the cleaner.

To permit the cleaner to operate economically under different air pressures, and in different hardnesses or thicknesses of scale, two interchangeable rear plates are provided with different port areas. The cleaner is of simple design and has few parts all made extra heavy to withstand the rough usage which such a tool must undergo. It is built for cleaning tubes from an inch to four inches in diameter, and a special design is suitable for use in curved tubes.

AUTOMATIC BOTTLE-MAKING MACHINE

An automatic bottle-making machine, invented and in use in Germany, is one of the triumphs of modern machine building. Doing the work of 250 expert glass blowers, it was considered such a menace to labor in Germany, where bottle-making is an industry of great magnitude, that the government is said to have limited its use by rather stringent rules.

The automatice making of bottles is accomplished through a great number of movable vacuum arms. A certain quantity of molten glass is drawn into the machine, air pressure is applied, and the glass is injected into an iron mold accommodating several bottles, then a device cuts the several bottles apart, the mold opens, and the bottles are automatically placed on a conveyor and transported to the cooling chamber. The machine can produce 2,000 bottles an hour.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - Editor
FRANK RICHARDS, - Managing Editor
F. C. IGLEHART, Jr., - Business Manager
W. C. LAROS, - - Circulation Manager

PUBLISHED BY THE

Compressed Air Magazine Company
Easton, Pa.

New York Office—Bowling Green Building.
London Office—165 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XVII. JULY, 1912. No. 7

CONTENTS

SCIENTIFIC MANAGEMENT AND THE ROCK DRILL

If we have in these days any considerable job of rock cutting or of rock excavation anywhere the most responsible and necessary item of the apparatus employed is the power driven—air, steam or electric-air—rock drill. Since its advent more rock has been removed from its native beds than in all the years of civilization before that, and the rate of rock removal and the quantities of rock to be removed increase with the years. The strenuous task of the drills and its rapid accomplishment has reacted upon its concomitants. It stirs all associated with it to a general hustle and still keeps itself ahead.

While the rock drill has been constantly developing into increased efficiency, the associate means connected with the handling of the materials liberated by it have not been able to keep pace with it. We might naturally have expected, as the drilling of the rock was the initiative operation and that which alone made all the other work possible, that the drill would be occupied most or all of the time, but really the drill has lots of standing around and waiting to do, hoists and cars and conveyors being employed more constantly. In the best records of tunnel driving that we have, say those of the Loetschberg tunnel, the actual working time for the drills was only two hours for each eight-hour shift. The drills, so far from holding back all the rest of the work, have really become the pacemakers in tunnelling and mining operations.

The fact is that what is now exploited as "scientific management," "motion study," "specialization of function," and the rest of it, were being developed, stimulated, promoted by the rock drill before these recent loud catchwords were thought of.

The drill itself has been improved in every detail and developed into types showing little relationship in design or in principle of operation to its earlier progenitor. The means of holding the drill securely when at work, so that it can be set quickly and fastened firmly and precisely and be pulled down and removed and brought forward and placed again by the average mine worker without baulk or delay, have been brought to great perfection. Then the selection of the bits and their maintenance have been given equal study, and the distribution and angle and depth and size of the holes,

varying according to the dimensions and scope of the work, the hardness of the rock, the pitch of the strata, have all demanded special consideration.

The determining of the best explosive for each special case, the size of the charges to be used to best throw or to most completely shatter the rock, the sequence and manner of firing of the several shots, constitute another line of responsibility only to be satisfied by long training and experience.

After the explosion in mine or tunnel the ventilation expert has his task. This is first to so remove or dilute the gas laden air that men will be able to resume operations at the face, and then follows the general problem of ventilation, of so maintaining a standard of purity for the air that the health of all the workers will not be seriously affected. This is the subject of unending legal enactment, and no man knows to this day what should be known upon this important topic.

And all this is only preliminary to the final, work which the rock drill stands for, the getting and the removing of material, some of it merely to get it out of the way by dumping it in some other place, much of it to be used in various ways; from quarries for building or monumental purposes, from mines for its intrinsic values. In all cases the most onerous actual work, requiring the most power and taking the most time, is the hoisting and conveying of material. In this work of detailed transportation at the beginning and of general transportation farther along is the life work of great engineers.

POSSIBLE FRAUDS IN AIR COMPRESSOR TESTS

The Electric Review of recent date thus suggests how it would be possible for an air compressor builder to convey an incorrect impression as to the efficiency of his machine.

In conducting air compressor tests, it says, the method usually adopted is to measure the time taken to pump a reservoir of known capacity up to a given pressure, or to require the compressor to maintain a given pressure when the air is escaping through a sharp edged orifice of known size. In both cases the temperature of the air in the reservoir should be noted, and this cannot be measured by holding a thermometer in the issuing jet, when the orifice method of test is used.

When the output of a compressor is being gauged by the pressure maintained behind a sharp edged orifice, it is the inspector's duty not merely to measure the orifice, but to satisfy himself that there is no obstruction, temporary or otherwise, to the free flow of air to the orifice.

When the reservoir test is being conducted, the usual method of fraud consists in having a quantity of water in the reservoir, thus reducing its capacity and shortening the time required to raise the air it contains to the specified pressure. The presence of water cannot easily be detected if the drain cock is fitted with an internal pipe terminating at a point above the bottom of the reservoir, so that the air is always drawn from the cock when it is opened.

Another method, largely practical when there are duplicate reservoirs, as in battleships, consists of slightly opening a junction valve for a few minutes and allowing air from another reservoir to enter the one to which the compressor is connected. By this means the compressor is helped to the desired extent, and if the trick is carried out unobserved, it is difficult of detection, as the gage readings are not fine enough to make the transaction readily visible.

Compressor builders will doubtless be duly grateful to their electric co-workers for these business suggestions.

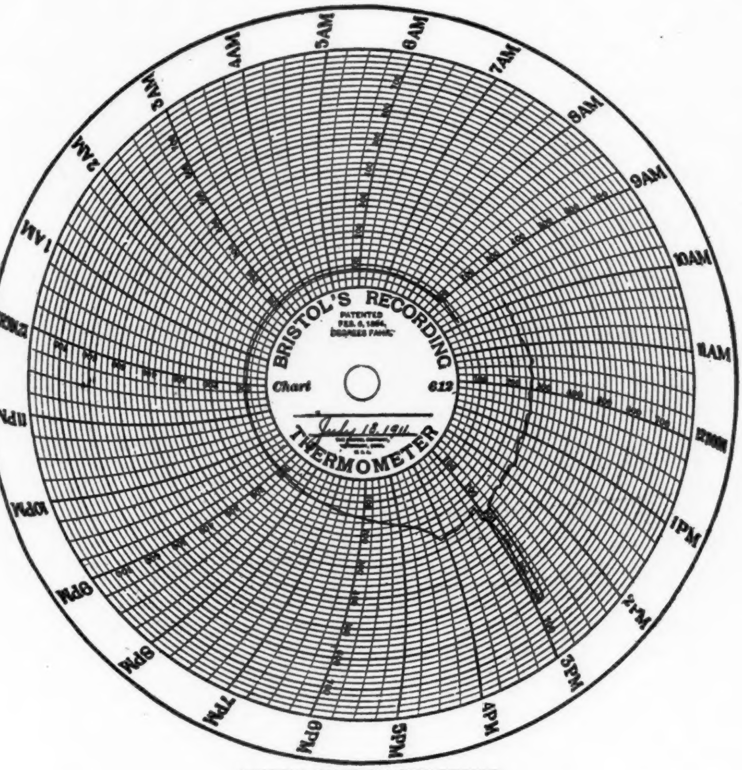
COMPRESSED AIR EXPLOSION WITH THERMOMETER RECORD

BY WILLIAM L. AFFELDER.*

While compressed air at high pressure has proven very satisfactory as a motive power in coal mines in which the use of electricity was not feasible, its use has not been entirely without fatalities. The dangers resulting from personal contact with conductors has, of course, been absent, but the use of compressed air has been attended by fatal accidents due to the disruption of parts of compressors or air lines, especially such parts of lines as were located adjacent to compressors.

This article is not a serious analysis of the theoretical points involved in such explosions, but is intended to display some data upon an actual explosion. While the writer was superintendent of the Redstone plant of the H. C. Frick Coke Co., at Brownfield, Pa., a vio-

*General Manager, Bulger Block Coal Co., Bulger, Pa.



SUDDEN JUMP IN THE RECORD.

lent explosion occurred on May 31, 1909, in the 5-inch discharge pipe of a four-stage Laidlaw-Dunn-Gordon air compressor which was producing air at 1,000 pounds pressure for two air locomotives. A hole larger than a man's head was blown in the piping within the compressor room, but fortunately no more serious damage was done than the blowing out of all of the windows of the building. The engineer was working about the compressor at the time, but was not injured.

The compressor was not damaged, and was restarted as soon as a new piece of pipe was put into the line. Several other compressor explosions occurred at about the same time at plants of other companies in the Connellsville region with fatal results.

The fact that the walls of the compressor room were liberally spattered with oil after the explosion, led to the belief that the explosion was, to a considerable extent at least, due to the use of an excessive quantity of oil. An investigation of the question of oil consumption bore out this conclusion, as it showed that the monthly consumption of compressor oil had been 52.2 gallons in 1908 and 12 gallons per month in 1909 up to the time of the explosion. The much smaller quantity in the latter period was due to the fact having been recognized that far too much oil had previously been used, but later observations showed that the reduction had not been sufficient.

While excess of oil in the cylinders and pipes was thought to have been the main cause of the explosion, it was thought that the direct cause of the ignition was the imperfect action of the fourth-stage valves of the compressor. It was not until more than 2 years later that corroborative evidence of a very interesting character was obtainable, perhaps the only positive internal record of the kind in existence.

Shortly after the original explosion, there was installed in the compressor house a Bristol recording thermometer especially designed to record continuously the temperature of the air at the point where it passed from the compressor into the pipe line. By noting the tem-

perature of the discharged air, the engineer was enabled to detect, in a measure at least, any serious defective operation of the compressor valves, for it soon became evident that, under normal conditions, the temperature of the discharged air should not exceed 250° Fahrenheit, although it seldom exceeded 240.°

As a further precaution, a fusible plug was placed in the discharge line near the compressor. This plug was made to blow out at a temperature of between 325 F. and 350° F. It might be added that these plugs, which have been patented jointly by Thomas McCaffrey, general manager of the Brier Hill Coke Co., and C. B. Hodges, of the H. K. Porter Co., are very extensively used, and have in numerous instances given evidences of internal conditions of such a nature that serious results would have occurred had it not been for the warning which they imparted. As a further precaution against explosions, the use of compressor oil was reduced to only 3.72 gallons per month throughout 1911, as a solution of castile soap and water was used almost exclusively for internal lubrication, with very satisfactory results.

The temperature chart for July 17, 1911, showed that the compressor was acting normally in every way. It showed a maximum temperature of but a trifle over 240 degrees F. at 12.20 a. m., after which it dropped to 220 degrees at noon, and registered 190 degrees and 230 degrees during the remainder of the day. The compressor was shut down at 4.45 p. m., and was restarted at 3.45 the next morning. Between 8 and 9 a. m. the temperature reached 250 degrees, but had dropped to 240 degrees when the chart for July 18 was put on the dial. This chart is reproduced in Fig. 1, and is worthy of very careful study.

It will be seen that by 11 a. m. it was evident that something was wrong with the internal mechanism of the compressor, for the temperature had crossed the 250 degree mark and continued to rise until it almost reached 270 degrees shortly after 11.15. The engineer did not fail to detect the rise in temperature, and upon investigation discovered that the fourth-stage discharge valves were not working satisfactorily, resulting in air working back from the air line into the fourth-stage cylinder. This "churning" of the air was producing heat more rapidly than the cooling water could accommodate. The engineer thought that, by careful running, he could finish the day, as the next day was to be a "lay-off day," and that he could then put in new valves or seats, or both, if necessary. He did not even consider the condition of the compressor as sufficiently serious to report the trouble to the master mechanic. He held the temperature between 250 degrees and about 265 degrees until almost 3 o'clock in the afternoon, when an internal explosion occurred.

The chart shows that this took place at 2.50, at a time when the temperature was slightly above 270 degrees. Coincident with the explosion the fusible plug melted and blew out, releasing the tension and checking the temperature at 620 degrees F. The compressor was immediately shut down and a new plug was put in, taking about 15 minutes, during which interval the temperature dropped to 245 degrees. The engineer then restarted the compressor, in which action he assumed an unnecessary risk, for the temperature again ascended to 270 degrees before it was shut down at 4.10 p. m.

After the defective valves and seats had been replaced with new ones, the compressor was put in operation on the 20th, and the chart for that day showed temperatures between 220 degrees and 240 degrees, but seldom as high as the latter figure, showing conclusively that the explosion was due to the churning of the air and that it was caused by leaking valves. The writer does not doubt that the warning imparted by the chart and the release of pressure afforded by the fusible plug averted a more serious explosion, although the practice of using soap solution and so little oil as was used, would likely have prevented an explosion of great magnitude.—*Mines and Minerals.*

NOTES

Gas Analysis as an Aid in Fighting Mine Fires. This is the title of Technical Paper 13, recently issued by the Bureau of Mines, which may be obtained free upon application to the Director, Bureau of Mines, Washington, D. C.

The number of passengers carried annually in the surface, elevated and subway lines of New York City exceeds by sixty per cent. the total number carried on the steam railways of the entire country.

A recent invention of some interest to motorists is that of a material called "Verre Sou-

ple" (flexible glass). It is said to be practically as transparent as glass, neglible in weight, unbreakable and suitable for wind-shields, windows, etc.

Casiano well No. 7, of the Huasteca Petroleum Company of Mexico, is said to be the greatest oil well in the world. For the last 17 months it has produced 11,000,000 bbl. under steadily increasing pressure, and now its average daily output is 25,000 barrels.

John R. Howells, of Plymouth, Pa., widely known as a manufacturer of drills, principally of the types used in coal mines, died May 27, sixty-seven years old. He began making his drills in 1878, and the plant he established is now operated by F. B. Spry. Mr. Howells lost a leg several years ago.

A mine telephone, required by a state law recently passed in Kansas, probably saved the lives of two shot firers employed in a mine near Pittsburg in that state. The men were cut off from the entry shaft by a gas explosion and telephoned to the top their location. A rescue party found both men unconscious, but after they were brought out they revived.

In a plant using compressed air through 60 ft. of hose for riveting, trouble was experienced in holding the pressure during the final setting of the rivet, the edge of the head becoming cold and not hugging snug to the plate. A bigger cylinder on the riveter did no good, but a receiver close to the riveter and a big connection pipe to the riveter remedied the trouble, providing sufficient air to follow up the riveter piston with little drop in pressure.

Liquefied gas will be manufactured in Kansas City, Mo., within the next year for distribution in western Missouri and Kansas and will be offered in competition with the natural gas in Kansas City if the prices there are increased, as planned. A $3,000,000 southwestern corporation, with a West Virginia charter, is considering the purchase of one of six sites in Kansas City for the manufacture of liquefied gas. It is one of eight similar corporations organized to build plants in different parts of the country.

Over 300 vessels are now afloat or under construction propelled by Diesel oil engines. This number includes 115 submarine torpedo boats, 30 other naval vessels, and a number of freight and passenger merchant vessels of 1200 to 3000 hp. France has over 60 submarine boats equipped with this engine. The United States has two just completed. The Diesel engine can use not only petroleum oils but tar oils, and oils produced by the distillation of lignite and shale. It has the highest fuel efficiency of any commercial heat engine.

A Manchester engineer has patented an apparatus which, it is claimed, will prevent the clouds of dust raised in dry weather by automobiles and other vehicles. The device, which is simple and inexpensive, collects the dust as it rises. The dust is drawn into conduits which are funnel-shaped at the mouth and which run from the rear of the front wheels to the rear of the back wheels. These conduits are connected with a box into which the dust is driven by the pressure of air, or this end can also be accomplished by the aid of a centrifugal fan geared to the driving shaft of the automobile. The contents of the dust box can be discharged by pulling a lever at the front of the vehicle.

In the northern part of Minnesota there is a great area of land so flat that its waters sometimes flow into Hudson bay and sometimes into the Gulf of Mexico. This area contains the headwaters of the Mississippi river. There are times when certain lakes discharge at both ends, the northern outlet taking the flow through Red river or Rainy river into Lake Winnipeg, and thence into Hudson bay; while the southern outlet leads to the Mississippi. From the same neighborhood water flows also to Lake Superior, and so over Niagara and down the St. Lawrence to the Atlantic.

A letter received some years ago by the Westinghouse Machine Co. said that the writer had been using one of its standard vertical engines with eminent satisfaction. For eight years it had been in continuous service night and day, handling its load without a hint of trouble, but that "upon shutting it down the other evening it went all to pieces." The letter was passed to the eminent inventor whose name the company bears, and handed back with the remark: "Ask the blamed fool what he shut it down for."

In driving the Laramie tunnel in Colorado the average depth of hole was 17½ ft.; a stick of 60 per cent. powder was placed in the bottom of the hole; then the primer, on top of which five sticks of powder were used except in the case of cut holes, each of which were loaded with three or four extra sticks. The three lifters were loaded to the collars in order that the broken ground should be thrown as far as possible from the face.

A physician in Dubuque, Ia., Dr. J. H. Schrupp, has found that the ordinary vacuum bottle provides a quick and sure way of growing microbes. He secured some of the inflamed tissue from a patient's throat upon absorbent cotton, placed it upon gelatine, and put it into the vacuum bottle, which had been filled with hot water at incubating temperature and emptied. He then found that he could grow the germs much more conveniently, with more cleanliness, and very much more rapidly than the health department was doing. Since his discovery he has reduced the time for diagnosing diphtheria, tonsilitis and typhoid fever from two and three days to five and ten hours.

While in Africa, Marconi accidentally made a discovery which is of the greatest importance. During some experiments in the desert he was surprised and gratified to find that wireless messages could be sent with absolute security over the desert without the usual masts Instead of poles, wire is laid on the sand in the direction in which the message is to be sent. It goes and is received without any interruption exactly the same as though the usual system were employed. This is made possible by the fact that the sand is an absolute non-conductor, so electric waves are not disturbed in any way. The sand being dry, neither rain nor tempest can affect the waves.

An oil engine exhaust muffler is used in the sewerage power station at Fairhaven, Mass., where a Hornsby-Akroyd engine drives an air compressor. The 5-in. exhaust is connected into one end of an 8-in. cast-iron pipe, which happened to be on hand. The pipe is made up of two lengths of 12 ft. each, and its outer end is led into a pit of field stones having a channel somewhat wider than the diameter of the pipe and about 30 in. deep and 10 ft. long. Some discarded boiler tubes were laid across the channel and on these stones were piled to a height of about 3 ft. The cooling water was led into the cast-iron muffler near the cylinder. The noise of the exhaust is muffled in the interstices between the stones.

Within a recent decade the farm area in the South devoted to peanut culture increased from 515,880 acres to 869,280 acres, or more than 68 per cent.; the crop, from 11,942,000 bushels to 19,404,000 bushels, or 62 per cent., and the value of the crop from $7,251,000 to $18,257,000, or 151 per cent. The average value per acre of the peanut crop of 1909 was $21 while the average acre value of other crops in the same year were wheat, $15.63; corn, $15.19; hay, $15,07; buckwheat, $14.61; flaxseed, $14.39; barley, $13.40; oats, $12.29, and rye, $11.87. It will thus be seen that the acre value of peanuts approached the class of rice, which averaged $26.85 an acre, and of cotton, which, with its seed, averaged $29.32 an acre.

Experiments are under way at the agricultural bacterioligical station at Vienna to increase the quantity of iron carried in certain plants, with a view to the effect on the human system when those plants are used as food. Artificially prepared foods containing iron do not always produce the desired effect, because the iron is not completely assimilated. This difficulty, it is thought, may be avoided by causing plants to take up an increased quantity of iron during their natural growth. By adding hydrate of iron to the soil in which it was growing, the experimenters have succeeded in producing spinach containing a percentage of iron seven times as great as that found in ordinary spinach. It is believed that the process will prove successful with other ferruginous plants.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MAY 7.

1,025,132. AUTOMATIC GUN OR RIFLE. WILLIAM M. DOUGLAS, Galveston, Tex.

2. In a fire arm of the character described, a barrel, a gas-cylinder having communication with the barrel and receiving gas therefrom on discharge, a piston operating within the gas-cylinder, *an air compressing cylinder*, a plunger operating within said air compressing cylinder, means

connecting the piston and plunger, a breech-bolt carrying an extractor and cooperating with the barrel, an element for locking the breech-bolt in its closed position, mechanism actuated by compressed air from the air compressing cylinder for operating said element, and means actuated by such compressed air for moving the breech-bolt after the same is unlocked.

1,025,135. PNEUMATIC PIANO - PLAYER. CHARLES FREBORG, Kankakee, Ill.

1,025,191. CARTRIDGE FOR THE PREPARATION OF OXYGEN. GEORGE FRANCOIS JAUBERT, Paris, France.

1. A cartridge for the preparation of oxygen or gaseous mixtures rich in oxygen comprising an envelope made of a combustible metal and filled with a pulverulent mixture containing a combustible substance and a substance substantially as described which when heated will give off oxygen to unite with the combustible substance and an excess of free oxygen, said pulverulent mixture being in direct contact with the metallic envelop, and said envelop having removable end covers, whereby the envelop serves for the tranportation of the mixture and also as a container during combustion.

1,025,199. CAN-TESTING MACHINE. CHARLES B. McDONALD, Chicago, Ill.

In a can testing machine, the combination of testing mechanism, a housing therefor, an air chamber in conjunction therewith, a source of pressure supply, a slidable tapered valve controlling communication between the source of pressure supply and the air chamber of the testing mechanism, including a member having a tapered seat for said valve, a tension member for normally maintaining said valve in wedging engagement with its seat, and means for periodically sliding and unseating said valve to permit the passage of air from the source of pressure supply to the air chamber, said tension mechanism effecting a quick return of said valve to normal position, substantially as described.

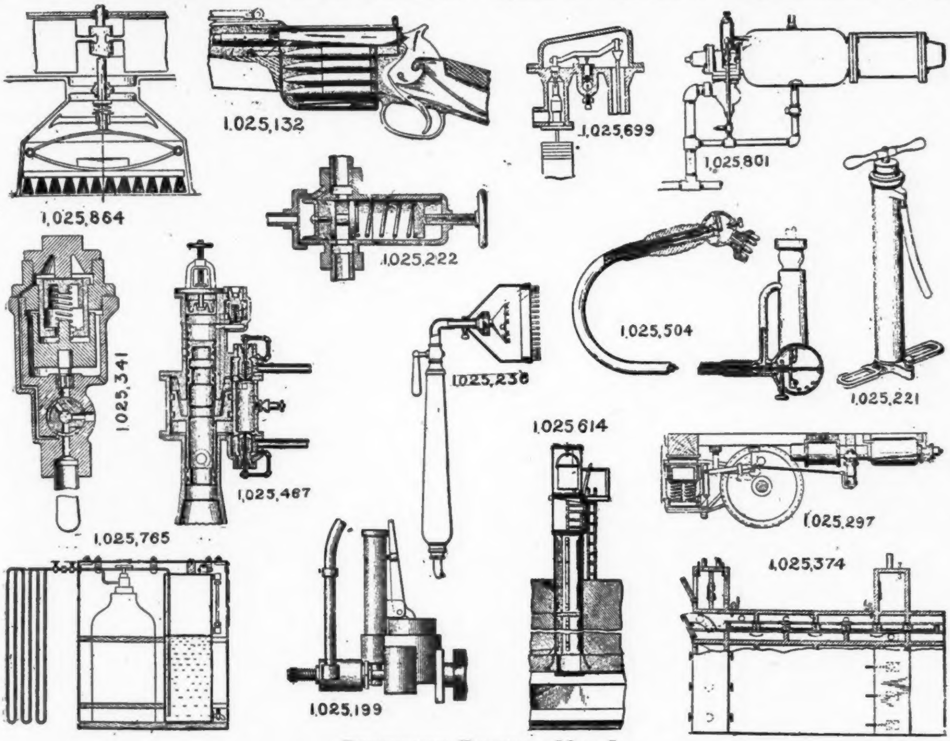
1,025,221. HAND - OPERATED AIR - PUMP. FRANK C. VIRTUE, Toronto, Ontario, Canada.

1,025,222. LIQUID-PRESSURE REGULATOR. JOSEPH D. WALLACE, Champaign, Ill.

1,025,236. VIBRATOR. HENRY BEHM, Jersey City, N. J.

1,025,297. LIGHT AND LOAD BRAKE APPARATUS. ROBERT A. PARKE, Parke Mines, Ontario, Canada.

1. In a light and load brake apparatus, the combination with the device for limiting the fluid pressure in the brake cylinder when the brakes are applied, of means controlled by the weight of the load for cutting said device into or out of operation.



PNEUMATIC PATENTS, MAY 7.

1,025,310. AUTOMATIC AIR-CURRENT-ACTUATED ALARM. LOUIS ROBILLOT, Besancon, France.

1,025,340. FLUID-PRESSURE-CONTROL APPARATUS. WALTER V. TURNER, Edgewood, Pa.

1,025,341. RETAINING-VALVE DEVICE. WALTER V. TURNER, Edgewood, Pa.

1. A pressure retaining valve device for the brake cylinder of a fluid pressure brake system comprising a loaded valve and fluid pressure operated means for varying the load on said valve to thereby retain different degrees of pressure in the brake cylinder.

1,025,374. PROCESS OF DEHYDRATING ANIMAL AND VEGETABLE SUBSTANCES. ERNEST WILLIAM COOKE, New York, N. Y.

1. The process of dehydrating succulent food substances without injuring their cell structure or texture, which consists in subjecting pervious masses of such substances to the dehydrating action of a flowing current of air in moisture absorbing condition passed through such masses in a chamber maintained under pressure, said air

being at a temperature too low to produce chemical changes in said succulent food substances and the air initially used in treating said substances containing some moisture, whereby the water is removed from them with substantially no loss of other substances and they are left in a condition such that they can be restored to their original undehydrated condition simply by the addition of water.

1,025,467. PULSATING APPARATUS. FRED D. HOLDSWORTH, Claremont, N. H.

1,025,504. COMBINED VIBRATOR AND VACUUM APPARATUS. JAMES BIRRELL and WILLIAM BIRRELL, Seattle, Wash.

1,025,614. CAISSON. OLIVER CROMWELL EDWARDS, Jr., Troy, N. Y.

1,025,699. APPARATUS FOR RAISING LIQUIDS BY COMPRESSED AIR. PAUL KESTNER, Lille, France.

1,025,765. REFRIGERATING APPARATUS. JOAQUIN GARCIA DE QUESADA, Barcelona, Spain.

1. In a refrigerating apparatus provided with a cooling coil, the combination of a portable generator comprising a container for gas under pressure and a closed receptacle divided by an apertured partition into a lower compartment for normally containing an absorbent of such gas and a communicating upper overflow compartment, a water glass on said overflow compartment, a valved pipe communicating with the lower portion of said lower compartment, a valved pipe leading from said container, and means for detachably securing said container pipe and lower compartment pipe respectively to the inlet and outlet of the coil.

1,025,801. AIR-BRAKE. JESSE B. GARDNER, Charleston, S. C.

1,025,864. VACUUM-CLEANER. DALLAS J. COGDILL, Spokane, Wash.

MAY 14.

1,025,962. METHOD OF EXTRACTING RARE GASES FROM THE AIR. GEORGE CLAUDE, Paris, France.

1. A process for separating rare gases from the atmosphere which consists in bringing cold compressed air into indirect contact with liquid oxygen or liquid rich in oxygen, thus liquefying the greater part of the oxygen and of the nitrogen of the air and causing the gaseous residue of this liquefaction to partially liquefy by circulating it in indirect contact with liquids rich in nitrogen and in oxygen.

1,025,994. VACUUM CLEANING SYSTEM. JOHN R. PETTIFORD, St. Louis, Mo.

1,026,104. PNEUMATIC SCRUBBING APPLIANCE. ALBERT E. MOORHEAD, San Fracisco, Cal.

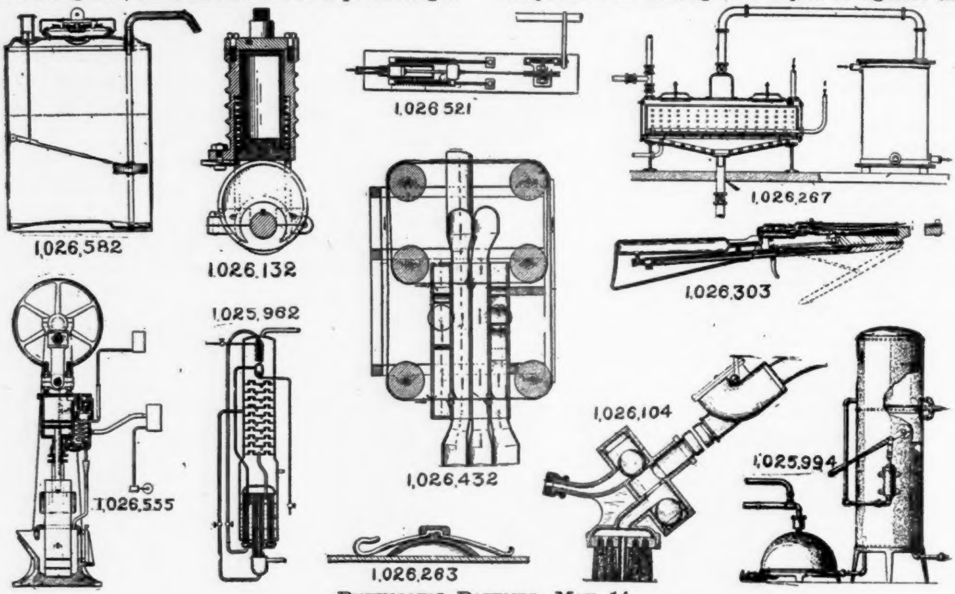
1,026,132. AIR-COMPRESSOR. WILLIAM R. THOMPSON, South Norwalk, Conn.

1,026,193. RELIEF-VALVE FOR PNEUMATIC CLEANING SYSTEMS. MORRIS S. WRIGHT, Worcester, Mass.

1,026,263. VACUUM SUPPORTING DEVICE. ROSS HAZELRIGG, Oakland, Cal.

1,026,267. PROCESS FOR RENOVATING COTTON-WASTE. JULIUS KAUFFMANN, Berlin, Germany.

The herein described process of renovating solid cotton waste, consisting in washing the same with a volatile solvent liquid and blowing compressed air through the liquid to agitate the waste, evaporating the solvent by the action of heat and simultaneously blowing compressed air through the waste to prevent packing, and finally drying the waste and blowing off dust by the action of compressed air.



PNEUMATIC PATENTS, MAY 14.

1,026,303. REPEATING AIR-RIFLE. ARTHUR V. DICKEY, Seattle, Wash.

1,026,371. VACUUM-CLEANER. WALTER T. SMITH, Jackson, Mich.

1,026,412. TUNNELING-MACHINE. RICHARD T. STONE, Deming, N. Mex.

1. In a tunneling apparatus of the kind described, an extended cylindrical shell formed with compartments accessible to one another, the forward end of said shell having a cylindrical cutting edge, means for compressing air in said compartments, a longitudinal rotary tube having its forward end projecting from the forward end of said shell and provided with a cutting head, and inlet apertures, mechanism for rotating said tube, and means for discharging water at the forward end of said shell.

1,026,432. PNEUMATIC FEATHER-CLEANING APPARATUS. CHARLES V. DEY, Chicago, Ill.

1,026,521. AIR-COMPRESSOR. ANDRE HENRI MARCOU, Versailles, France.

1. In an air compressor, the combination of a

piston, a heavy body secured on the piston rod, an elastic device for throwing forward said piston and its body, a device for stretching the elastic device and a releasing device for allowing said elastic device to suddenly unstretch.

1,026,553. VACUUM-CLEANER. LONNIE A. BAXTER, Cincinnati, Ohio.

1,026,555. PNEUMATIC PERCUSSIVE APPARATUS. HANS CHARLES BEHR, Johannesburg, Transvaal.

1,026,582. DISPENSING-CAN. CHAUNCEY A. HERTENSTEIN and WILLIAM F. PROBST, Chillicothe, Ohio.

1. A dispensing can comprising a tank, a discharge pipe, an air compressing device on said tank for forcing air thereinto, and means for admitting the air under pressure to the said pipe near its mouth to simultaneously cut off the flow of liquid and exhaust the compressed air.

MAY 21.

1,026,656. CAISSON. RALPH H. CHAMBERS, New York, N. Y.

in the melting chamber, substantially as and for the purposes described.

1,026,756. PROCESS OF TREATING MILK. JOHN MCINTYRE, Jersey City, N. J.

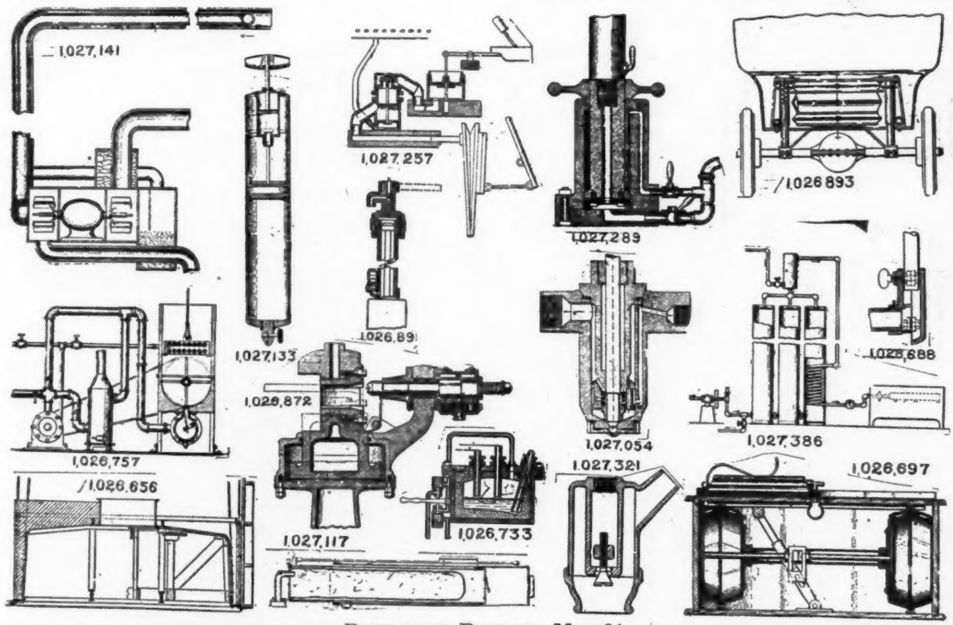
1,026,757. APPARATUS FOR DRYING MILK. JOHN MCINTYRE, Jersey City, N. J.

1. An apparatus for drying milk, comprising a vessel for containing the milk and having an open top and a bottom semi-circular in cross section, the said bottom being provided with an air induction slot extending throughout the length of the bottom, an agitator in the bottom portion of the vessel sweeping the surface of the bottom portion, and an air supply connected with the said slot, for forcing a blast of compressed air through the slot into the milk, as set forth.

1,026,872. FLUID - CONTROLLED DRILL-STEEL-FORMING AND DRILL-BIT-SHARPENING MACHINE. JOHN GEORGE LEYNER, Denver, Colo.

1,026,891. HAND-RAMMER. FRANZ WEGNER, Halle, Germany.

1,026,893. PNEUMATIC CUSHION FOR VEHICLES. FRED I. BAKER, Orange, Mass.



PNEUMATIC PATENTS, MAY 21.

1,026,688. SAND-BLAST DEVICE. WALTER MACLEOD, Fort Thomas, Ky., and WILLIAM HEXT, Cincinnati, Ohio.

2. In a sand blast device, a sand collector, consisting of a pan and a cover for the pan, the pan projecting beyond the front edge of the cover, and thereby forming an air inlet port, a sand delivery port, and a port provided in said cover between said air inlet and said sand delivery port for admitting sand to said collector.

1,026,697. VACUUM ERASER-CLEANER. CLARENCE W. POLLEY, Skaneateles, N. Y.

1,026,732. APPARATUS FOR DISTRIBUTING FUEL IN INTERNAL-COMBUSTION ENGINES. HANS TH. BRUNS, Nuremberg, Germany.

1,026,733. PROCESS FOR CASTING METALS. FRANZ DE BUIGNE, Magdeburg, Germany.

1. In a process of casting molten metals under pressure, which consists in heating a metal bath internally, suddenly releasing the pressure established by an indifferent gas so as to produce by the rapid escape of the gases a partial vacuum

1,027,054. ATOMIZER FOR LIQUID-FUEL MOTORS. JOSEPH LEFLAIVE, St.-Etienne, France.

1,027,060. PNEUMATIC HAMMER. REINHOLD A. NORLING, Aurora, Ill.

1,027,061. AUTOMATIC THROTTLE-VALVE-LOCKING MECHANISM FOR PNEUMATIC TOOLS. REINHOLD A. NORLING, Aurora, Ill.

1,027,062. PNEUMATIC HAMMER. REINHOLD A. NORLING, Aurora, Ill.

1,027,117. VACUUM-CLEANER. WILLIAM R. FOWLER, Baltimore, Md.

1,027,133. FIRE-EXTINGUISHER. ERNEST M. LAWRENCE, New York, N. Y.

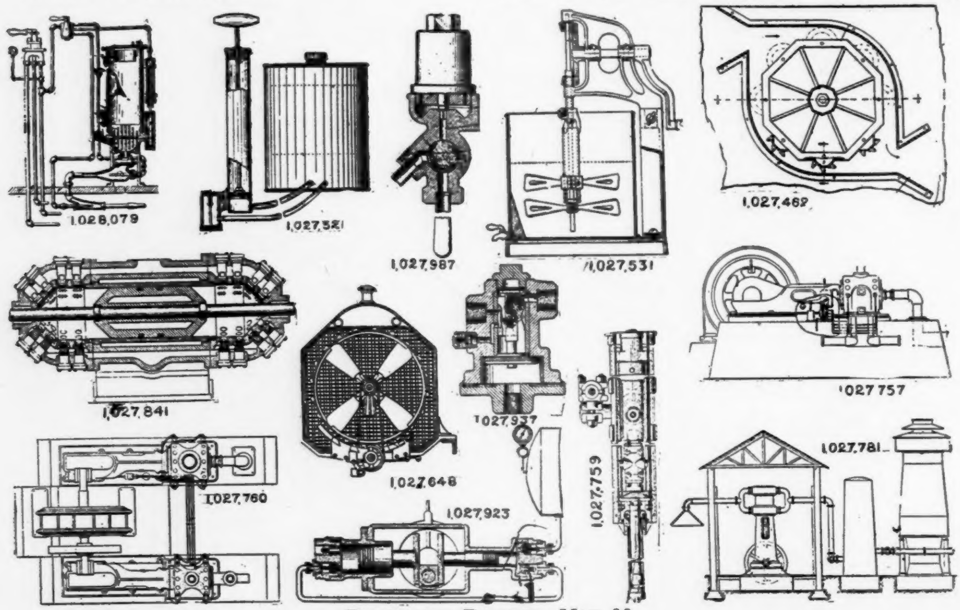
1. A device of the character specified, including in combination, an elongated casing, an air-compressor mounted at one end of said casing and including a compression-chamber within said casing, a piston working in said chamber, and valves communicating therewith, and a floating material-expelling member slidably disposed in said casing independently of said air-compressor and movable under the influence of the compressed medium produced by the said compressor.

1,027,141. AIR-TEMPERING DEVICE. FRANK P. MIES, Chicago, Ill.
1,027,257. PNEUMATIC ACTION FOR SELF-PLAYING PIANOS. WALTER A. KRUCK, Camden, N. J.
1,027,288. CUSHIONING DEVICE FOR VEHICLES. JOHN C. SHERMAN, Brookline, Mass.
1,027,289. RIVETING - MACHINE. EDWIN SMITH, Viau Ville, Montreal, Quebec, Canada.
1,027,321. HYDRAULIC AIR-EJECTOR. ERNEST E. CLEVELAND, Springfield, Mass.
1,027,386. HYDRAULIC FLUID-COMPRESSOR. ALDA F. HAWKINS, Dallas, Tex.

MAY 28.

1,027,461. AIR-GAGE. JOSEPH A. BUTTRESS, Los Angeles, Cal.
1,027,462. AIR-PROPELLED CAR-FAN. JOHN L. COUNCIL, JAMES E. THARPE, and THOMAS M. DALE, Statesville, N. C.
1,027,757. UNLOADER FOR FLUID-COMPRESSORS. WILLIAM PRELLWITZ, Easton, Pa.
1,027,758. UNLOADER FOR COMPOUND FLUID - COMPRESSORS. WILLIAM PRELLWITZ, Easton, Pa.
1,027,759. SUPPORT FOR MINING TOOLS OR MACHINES. WILLIAM PRELLWITZ, Easton, Pa.
1,027,760. UNLOADER FOR FLUID-COMPRESSORS. WILLIAM PRELLWITZ, Easton, Pa.
1,027,781. APPARATUS FOR SUPPLYING AIR TO BLAST-FURNACES, CONVERTERS, AND THE LIKE. RALPH H. SWEETSER, Columbus, Ohio.
1,027,817. LIQUEFACTION OF GASES. GEORGE CLAUDE, Paris, France.

1. The method of liquefying permanent gases which consists in subjecting a compressed and cooled permanent gas to the indirect cooling action of another expanded permanent gas with a lower critical temperature, the remaining cold of which after being utilized for liquefying purpose is used in cooling both compressed permanent gases the one to be liquefied and the other to be expanded.



PNEUMATIC PATENTS, MAY 28.

1,027,493. FLUID-OPERATED CLUTCH. JOHN R. MCGIFFERT, Duluth, Minn.
1,027,521. SPRAYING DEVICE. HENRY E. BRANDT, Minneapolis, Minn.
1,027,531. AERATING BUTTER-SEPARATOR. ALPHEUS FAY, Louisville, Ky.
1,027,648. ENGINE-STARTER. EDWIN GUTHRIE, Washington, D. C.

1. In an engine starter, the combination with an engine having an engine shaft, of a revoluble fan arranged to cause air to flow over the engine to cool the same, the said fan having a series of buckets, means constructed to transmit the movement of the engine shaft to the fan and the movement of the fan to the engine shaft, a fluid storage tank, a member having jet nozzles directed toward the buckets of the fan, and tubular connections including a cut-off valve and arranged between the tank and said member.

1,027,695. CLAMP FOR FLASKS. EDSON C. COVERT, Chicago, Ill.

1. A clamp comprising, in combination, a support, a clamp member rotatably and slidably connected to said support, a reciprocating member arranged to act upon said clamping member, and fluid pressure means for actuating said reciprocating member, substantially as described.

1,027,823. APPARATUS FOR TESTING AIR. ROBERT HENRY DAVIS, London, England.
1,027,841. FLUID-COMPRESSOR. HARRY D. HILDEBRAND, Pittsburgh, Pa.
1,027,862-3. APPARATUS FOR THE SEPARATION OF HYDROGEN FROM A GASEOUS MIXTURE. CARL VON LINDE, Munich, Germany.
1,027,923. AIR-PUMP. GREGORY JOHN SPOHRER, Franklin, Pa.
1,027,937. EXHAUST-CONTROL VALVE FOR AIR-BRAKES. WALTER V. TURNER, Edgewood, Pa.
1,027,938-9. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.
1,027,987. PRESSURE-RETAINING VALVE. THOMAS L. BURTON, Elizabeth, N. J.
1,028,073. AIR-HEATING APPARATUS. ALBERT EDWARD JONES, Flume, Austria-Hungary.
1,028,079. AIR TRACK-SANDING APPARATUS. WILLIAM A. SAULT, Worcester, Mass.
1,028,080. AIR-PUMP. CHARLES F. SNYDER, Allegheny, Pa.